Vol. I

TRANSCRIPT OF RECORD

Supreme Court of the United States

OCTOBER TERM, 1938

No. 441

THE ELECTRIC STORAGE BATTERY CO.,
PETITIONER,

vs.

GENZO SHIMADZU AND NORTHEASTERN ENGINEERING CORPORATION

ON WRIT OF CERTIORARI TO THE UNITED STATES CIRCUIT COURT OF APPEALS FOR THE THIRD CIRCUIT

PETITION FOR CERTIORARI FILED OCTOBER 27, 1938.

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IN THE

District Court of the United States

FOR THE EASTERN DISTRICT OF PENNSYLVANIA.

No. 7727 March Term 1933.

Rawle & Henderson, Esqs. for Genzo Shimadzu and Northeastern Engineering Corporation. Hunt, Hill & Betts, Esqs. Edmund B. Whitcomb, Esq. George H. Souther, Esq.	GENZO SHIMADZU and NORTHEASTERN ENGINEERING CORPORATION	
	vs.	
H. M. Morris, Esq. A. B. Stoughton, Esq. E. S. W. Farnum, Jr., Esq. for The Electric Storage Battery Co.	THE ELECTRIC STORAGE BATTERY CO.	

DOCKET ENTRIES.

1933

June 1 Bill of Complaint; filed.

1 Subpoena exit—returnable June 21, 1933.

3 Copy of Certificate forwarded to Commissioner of Patents, filed.

5 Subpoena returned on June 1, served and filed.

12 Printed copy of bill of complaint, filed.

12 Appearance of H. M. Morris, Esq., A. B. Stoughton, Esq., and E. S. W. Farnum, Jr., Esq., for defendant, filed.

23 Stipulation of counsel extending time in which to file answer, filed.

Aug.	9	Stipulation of counsel further extending time in which to file answer, filed.
Sept.	16	Stipulation of counsel extending time in which to file answer, filed.
	27	Bond for costs by Northeastern Engineering Corporation, with surety, in $250. and Decree approving bond, filed.
Oct.	13	Stipulation of counsel extending time in which to file answer, filed.
	30	Answer filed.
Nov.	11	Stipulation of counsel extending plaintiff's time in which to file and serve interrogatories, filed.
	28	Printed copy of answer, filed.
Dec.	19	Affidavit by L. S. Ishimura, filed.
	19	Notice of presenting motion and Motion by plaintiff for leave to inspect defendants plant, filed.
	19	Defendants answer to Motion, filed.
	19	Stipulation of counsel extending time in which to file interrogatories, filed.
	19	Argued sur motion for leave to inspect defendant's plant.
	20	Affidavit by Edward W. Smith, filed.
1934		
Jan.	5	Testimony filed.
	22	Stipulation of counsel extending time of plaintiffs in which to file and serve interrogatories, etc., filed.
	30	Printed copy of defendants answer and argument in opposition to motion for inspection, filed.
Feb.	5	Opinion, Kirkpatrick, J., granting leave to enter decree granting lease to inspect plant of defendant company, filed.

Apr.	17	Decree appointing J. Hunt Wilson as expert for purpose of inspecting defendants plants and reporting to the Court, filed.
	24	Stipulation of counsel extending time in which to take depositions, etc., and Decree approving stipulation, filed.
July	6	Application by plaintiffs for order to obtain additional samples and notice of presentation of application, filed.
	6	Decree denying application for order to obtain additional samples without prejudice, filed.
1935		
Jan.	17	Plaintiffs' objections to defendant's proposed inter partes tests at Toronto, Canada, and acknowledgement of receipt of copy thereof by counsel for defendant, filed.
May	28	Stipulation of counsel extending time for taking depositions etc., and Order of Court approving same, filed.
June	8	Notice of motion for leave to amend answer, filed.
	8	Notice of Defendant's motion for bill of particulars and motion for bill of particulars, filed.
	8	Notice of motion, motion for leave to file interrogatories, and interrogatories propounded by defendant, filed.
	22	Plaintiffs interrogatories to defendant, filed.
July	9	Decree directing Letters Rogatory to issue to Kyoto, Japan, filed.
	9	Plaintiffs motion for better particulars of defense filed.

Aug.	7	Interrogatories, filed.
	29	Defendants Bill of Particulars, filed.
	29	Answer by R. C. Norberg to interrogatories filed.
	29	Cross Interrogatories to G. Shimadzu, filed.
Sept.	19	Answers of Northeastern Engineering Corp. & G. Shimadzu to interrogatories, filed.
	19	Plaintiffs' bill of particulars, filed.
	23	Decree amending decree of July 3, 1935, providing for issuance of Letters Rogatory to Japan, filed.
	23	Letters Rogatory to Kyoto Japan, exit.
	25	Argued sur Pleading & proofs. Amended answer to plaintiffs interrogatory 6, filed.
	26	Hearing continued
Sept.	27	Hearing continued.
	30	Hearing continued.
Oct.	1	Hearing continued
	2	Hearing continued
	3	Hearing continued
	4	Hearing continued
	7	Hearing continued
	8	Hearing continued
	9	Hearing continued.
	10	Hearing concluded.

1936

Jan.	27	Stipulation of counsel extending time for filing defendant's brief, filed.
Feb.	17	Testimony (12 vol.) filed.
Mar.	14	Letters Rogatory from Japan received opened and filed.
	26	Stipulation of counsel extending time to and including April 16, 1936 in which to file reply brief, filed.

Apr. 16 Stipulation of counsel extending time to and including April 30, 1936, in which to file reply brief, filed.
July 14 Argued sur pleadings and proofs.
Oct. 6 Opinion, Kirkpatrick, J., sur pleadings and proofs filed.
Nov. 20 Memorandum amending opinion (Kirkpatrick, J.) filed.
Dec. 14 Final decree in favor of plaintiffs with costs, filed.
14 Petition for Appeal, filed.
14 Order of Court allowing appeal, filed.
14 Assignments of Error, filed.
14 Bond sur appeal in $50,000. with U. S. Guarantee Co., Surety, and Order of Court approving bond, filed.
14 Citation allowed and issued.
14 Copy of notice of appeal, filed.
19 Citation returned: "service accepted" and filed.
23 Certificate of termination of suit transmitted to Comm'r. of Patents and copy filed.

1937

Jan. 11 Order of Court extending time for perfecting appeal, filed.
12 Petition for Cross-Appeal by plaintiffs, filed.
12 Order of Court allowing appeal, filed.
12 Plaintiffs assignments of error, filed.
12 Bond sur appeal in $250. with Aetna Casualty & Surety Co., surety and Order of Court approving bond, filed.
12 Citation allowed and issued.
12 Copy of service of Appeal, filed.

13 Citation returned "Service accepted" and filed.

Feb. 10 Order of Court extending defendants time for filing record on appeal, filed.

Mar. 13 Order of Court extending time for perfecting appeals, filed.

Apr. 19 Stipulation of counsel and Order of Court approving narrative statement of evidence etc., filed. (3 vol.)

May 1 Order of Court extending defendants time for filing record on appeal filed.

" 1 Certified copy of Order of U. S. Circuit Court of Appeals granting leave to defendant to apply to this Court to take additional testimony filed.

" 10 Petition of defendant to vacate interlocutory decree and to reopen case filed.

" 28 Answer of plaintiffs to petition for rehearing filed.

June 10 Printed copy of Petition to reopen case filed.

July 3 Praecipe for transcript of record sur appeal filed.

" 7 Order of Court extending time for filing record on appeal filed.

Sept. 14 Opinion, Kirkpatrick, J., denying petition of defendant to take new evidence etc., filed.

Oct. 4, Decree dismissing petition of defendant to take new evidence etc., with costs, filed.

IN THE
DISTRICT COURT OF THE UNITED STATES
FOR THE EASTERN DISTRICT OF PENNSYLVANIA.

IN EQUITY NO. 7727.

March Term, 1933.

GENZO SHIMADZU AND NORTHEASTERN ENGINEERING CORPORATION,
Plaintiffs.

v.

THE ELECTRIC STORAGE BATTERY CO.,
Defendant.

BILL OF COMPLAINT.

(Filed June 1, 1933.)

To the Honorable the Judges of the United States District Court for the Eastern District of Pennsylvania:

Now come the plaintiffs above named and for their Bill of Complaint respectfully allege as follows on information and belief:

1. Plaintiff, Genzo Shimadzu, is a subject of the Empire of Japan and a resident of the City of Kyoto, Empire of Japan.

2. Plaintiff, Northeastern Engineering Corporation, is a corporation organized and existing under and by virtue of the laws of the State of Delaware,

a citizen of Delaware, having its principal place of business at Wilmington, and a resident of Wilmington, in the County of Newcastle, State of Delaware.

3. Defendant, The Electric Storage Battery Company, is and was at the times hereinafter mentioned, a corporation organized and existing under and by virtue of the laws of the State of New Jersey, a citizen of New Jersey, and a resident and having its principal, regular and established places of business within this district at Allegheny Avenue and Nineteenth Street, at No. 1935 Hunting Park Avenue, and at Rising Sun Avenue and Asylum Park, City of Philadelphia, County of Philadelphia, State of Pennsylvania, within which District it has committed and now is committing acts of infringement of which complaint is made herein.

4. This is a suit in Equity under the Patent Laws of the United States.

5. Before July 14, 1923, plaintiff, Genzo Shimadzu, was the true, original, first and sole inventor or discoverer of a certain new and useful Process of Manufacturing Powder of Lead Suboxide Intermingled with Powder of Metallic Lead and the product thereof not known or used by others in this country prior to his invention or discovery thereof, nor patented nor described in any printed publication in this or any foreign country prior to his invention or discovery, nor more than two years prior to said July 14, 1923, and not in public use or on sale in this country more than two years prior to said July 14, 1923, and not first patented in any foreign country by him or his representatives or assigns on an

application filed more than twelve months prior to said July 14, 1923, and not abandoned.

6. On said July 14, 1923, said Genzo Shimadzu did make application in writing to the Commissioner of Patents of the United States, Serial No. 657,621, for Letters Patent for his said invention or discovery in Process of Manufacturing Powder of Lead Sub oxide Intermingled with Powder of Metallic Lead and the product thereof according to the form of the statute in such cases made and provided; and after due and lawful proceedings had and due examination made by the Commissioner of Patents, Letters Patent of the United States No. 1,584,150 were on the eleventh day of May, 1926, granted unto plaintiff, Genzo Shimadzu, his heirs and assigns, as the result of said application and were signed by the proper officers of the United States Patent Office, and sealed with the seal of the United States Patent Office, and duly recorded in the United States Patent Office in books kept for the purpose, whereby there was granted to said Genza Shimadzu, his heirs and assigns, for the term of seventeen years next succeeding the said eleventh day of May 1926, the exclusive right to make, use and vend the said invention throughout the United States and territories thereof, a complete description of which invention was contained in the specifications of which a copy was attached to and made a part of said Letters Patent. The original or a certified copy of said Letters Patent is here in court ready to be produced.

7. Before January 30, 1922, plaintiff Genzo Shimadzu, was the true, original, first and sole inventor or discoverer of a certain new and useful Method of

Manufacturing Metal Powder not known or used by others in this country prior to his invention or discovery thereof, nor patented nor described in any printed publication in this or any foreign country prior to his invention or discovery, nor more than two years prior to said January 30, 1922, and not in public use or on sale in this country more than two years prior to said January 30, 1922, and not first patented in any foreign country by him or his representatives or assigns on an application filed more than twelve months prior to said January 30, 1922, and not abandoned.

8. On said January 30, 1922, said Genzo Shimadzu did make application in writing to the Commissioner of Patents of the United States, Serial No. 532,920, for Letters Patent for his said invention or discovery in Method of Manufacturing Metal Powder according to the form of the statue in such cases mde and provided; and after due and lawful proceedings had and due examination made, by the Commissioner of Patents, Letters Patent of the United States No. 1,584,149 were on the eleventh day of May, 1926, granted unto plaintiff, Genzo Shimadzu, his heirs and assigns, as the result of said application and were signed by the proper officers of the United States Patent Office and sealed with the seal of the United States Patent Office, and duly recorded in the United States Patent Office in books kept for the purpose, whereby there was granted to said Genzo Shimadzu, his heirs and assigns, for the term of seventeen years next succeeding the eleventh day of May, 1926, the exclusive right to make, use and vend the said invention throughout the United States and territories thereof, a complete description of which invention was contained in the specifications of which a copy was

attached to and made a part of said Letters Patent. The original or a certified copy of said Letters Patent is here in court ready to be produced.

9. Before April 18, 1924, plaintiff, Genzo Shimadzu, was the true, original, first and sole inventor or discoverer of a certain new and useful Process of Manufacturing Lead Oxide not known or used by others in this country prior to his invention or discovery thereof, nor patented nor described in any printed publication in this or any foreign country prior to his invention or discovery, nor more than two years prior to said April 18, 1924, and not in public use or on sale in this country more than two years prior to said April 18, 1924, and not first patented in any foreign country by him or his representatives or assigns on an application filed more than twelve months prior to said April 18, 1924, and not abandoned.

10. On said April 18, 1924, said Genzo Shimadzu did make application in writing to the Commissioner of Patents of the United States, Serial No. 707,509, for Letters Patent for his said invention or discovery in Process of Manufacturing Lead Oxide according to the form of the statute in such cases made and provided; and after due and lawful proceedings had and due examination made by the Commissioner of Patents, Letters Patent of the United States No. 1,584,151 were on the eleventh day of May, 1926, granted unto plaintiff, Genzo Shimadzu, his heirs and assigns, as the result of said application and were signed by the proper officers of the United States Patent Office and sealed with the seal of the United States Patent Office, and duly recorded in the United States Patent Office in books kept for the purpose, whereby there was

granted to said Genzo Shimadzu, his heirs and assigns, for the term of seventeen years succeeding the said eleventh day of May, 1926, the exclusive right to make, use and vend the said invention throughout the United States and territories thereof, a complete description of which invention was contained in the specifications of which a copy was attached to and made a part of said Letters Patent. The original or a certified copy of said Letters Patent is here in court ready to be produced.

11. Before April 18, 1924, plaintiff, Genzo Shimadzu, was the true, original, first and sole inventor or discoverer of a certain new and useful Paint not not known or used by others in this country prior to his invention or discovery thereof, nor patented nor described in any printed publication in this or any foreign country prior to his invention or discovery, nor more than two years prior to said April 18, 1924, and not in public use or on sale in this country more than two years prior to said April 18, 1924, and not first patented in any foreign country by him or his representatives or assigns on an application filed more than twelve months prior to said April 18, 1924, and not abandoned.

12. On said April 18, 1924, said Genzo Shimadzu did make application in writing to the Commissioner of Patents of the United States, Serial No. 707,510, for Letters Patent for his said invention or discovery in Paint according to the form of the statutee in such cases made and provided; and after due and lawful proceedings had and due examination made by the Commissioner of Patents, Letters Patent of the United States No. 1,584,152, were on the eleventh day of May, 1926, granted unto plaintiff, Genzo Shi-

madzu, his heirs and assigns, as the result of said application and were signed by the proper officers of the United States Patent Office and sealed with the seal of the United States Patent Office, and duly recorded in the United States Patent Office in books kept for the purpose, whereby there was granted to said Genzo Shimadzu, his heirs and assigns, for the term of seventeen years next succeeding the said eleventh day of May, 1926, the exclusive right to make, use and vend the said invention throughout the United States and territories thereof, a complete description of which invention was contained in the specifications of which a copy was attached to and made a part of said Letters Patent. The original or a certified copy of said Letters Patent is here in court ready to be produced.

13. Before February 20, 1923, plaintiff, Genzo Shimadzu, was the true, original, first and sole inventor or discoverer of a certain new and useful Process of Making Plates for Storage Batteries Using Lead Suboxide not known or used by others in this country prior to his invention or discovery thereof, nor patented nor described in any printed publication in this or any foreign country prior to his invention or discovery, nor more than two years prior to said February 20, 1923, and not in public use or on sale in this country more than two years prior to said February 20, 1923, and not first patented in any foreign country by him or his representatives or assigns on an application filed more than twelve months prior to said February 20, 1923, and not abandoned.

14. On said February 20, 1923, said Genzo Shimadzu did make application in writing to the Commissioner of Patents of the United States, Serial No.

620,267, for Letters Patent for his said invention or discovery in Process of Making Plates for Storage Batteries Using Lead Suboxide according to the form of the statute in such cases made and provided; and after due and lawful proceedings had and due examination made by the Commissioner of Patents, Letters Patent of the United States No. 1,584,479 were on the eleventh day of May, 1926, granted unto plaintiff, Genzo Shimadzu, his heirs and assigns, as the result of said application and were signed by the proper officers of the United States Patent Office and sealed with the seal of the United States Patent Office, and duly recorded in the United States Patent Office in books kept for the purpose, whereby there was granted to said Genzo Shimadzu, his heirs and assigns, for the term of seventeen years next succeeding the said eleventh day of May, 1926, the exclusive right to make, use and vend the said invention throughout the United States and territories thereof, a complete description of which invention was contained in the specifications of which a copy was attached to and made a part of said Letters Patent. The original or a certified copy of said Letters Patent is here in Court ready to be produced.

15. Before April 27, 1926, plaintiff, Genzo Shimadzu, was the true, original, first and sole inventor or discoverer of a certain new and useful Apparatus for the Continuous Production of Lead Oxides in the Dry State, not known or used by others in this country prior to his invention or discovery thereof, nor patented nor described in any printed publication in this or any foreign country prior to his invention or discovery, nor more than two years prior to said April 27, 1926, and not in public use or on sale in this country more than two years prior to said April 27,

1926, and not first patented in any foreign country by him or his representatives or assigns on an application filed more than twelve months prior to said April 27, 1923, and not abandoned.

16. On said April 27, 1926, said Genzo Shimadzu did make application in writing to the Commissioner of Patents of the United States, Serial No. 104,999, for Letters Patent for his said invention or discovery in Apparatus for the Continuous Production of Lead Oxides in the Dry State according to the form of the statute in such cases made and provided, which said application was subsequently renewed on June 21, 1929; and after due and lawful proceedings had and due examination made by the Commissioner of Patents, Letters Patent of the United States No. 1,896,020 were on the thirty-first day of January, 1933, granted unto plaintiff, Genzo Shimadzu, his heirs and assigns, as the result of said application and were signed by the proper officers of the United States Patent Office and sealed with the seal of the United States Patent Office, and duly recorded in the United States Patent Office in books kept for the purpose, whereby there was granted to said Genzo Shimadzu, his heirs and assigns, for the term of seventeen years next succeeding the said January 31, 1933, the exclusive right to make, use and vend the said invention throughout the United States and territories thereof, a complete description of which invention was contained in the specifications of which a copy was attached to and made a part of said Letters Patent. The original or a certified copy of said Letters Patent is here in Court ready to be produced.

17. By an instrument in writing, signed, sealed and delivered in due from of law on the fourteenth

day of February, 1933, said plaintiff Genzo Shimadzu gave and granted unto plaintiff, Northeastern Engineering Corporation, an exclusive license for the whole of the United States, its territories and possessions, to employ the process described and claimed in said Letters Patent of the United States in suit, No. 1,584,150, No. 1,584,149, No. 1,584,151, No. 1,584,152, No. 1,584,479 and No. 1,896,020, and to manufacture, use and sell the product made according to and embodying the inventions described and claimed in said Letters Patent of the United States No. 1,584,150, No. 1,584,149, No. 1,584,151, No. 1,584,152, No. 1,584,479 and No. 1,896,020, together with the right to license others to employ the process described and claimed in, and to manufacture, use and sell product made according to and embodying the inventions of said Letters Patent in suit No. 1,584,150, No. 1,584,149, No. 1,584,151, No. 1,584,152, No. 1,584,479 and No. 1,896,020.

Profert of said exclusive license or a duly authenticated copy thereof is hereby made.

18. Since the granting of said Letters Patent of the United States in suit, No. 1,584,150, No. 1,584,149, No. 1,584,151, No. 1,584,152, No. 1,584,479 and No. 1,896,020, the plaintiff, Genzo Shimadzu, has been and now is vested with legal title in and to the same and that since the said grant and transfer to plaintiff, Northeastern Engineering Corporation, of said exclusive license thereunder, it has been and now is vested with an exclusive license to employ the process described and claimed in, and to manufacture, use and sell the product made according to and embodying the inventions described and claimed in said Letters Patent of the United States in suit, No. 1,584,150, No. 1,584,149, No. 1,584,151, No. 1,584,152, No. 1,584,479

and No. 1,896,020, with the right to grant licenses to others to employ the process described and claimed in, and to manufacture, use and sell the product made according to and embodying the inventions of said Letters Patent in suit, No. 1,584,150, No. 1,584,149, No. 1,584,151, No. 1,584,152, No. 1,584,479 and No. 1,896,020.

19. Under each of the aforesaid Letters Patent licenses to practice the processes and/or methods disclosed and/or claimed therein and licenses to make, use and/or sell the products disclosed and/or claimed therein have been granted to the following corporations:

1. Northeastern Engineering Corporation, a a corporation organized and existing under and by virtue of the laws of the State of Delaware, having its principal place of business in Wilmington, Delaware.

2. U S L Battery Corporation, a corporation organized and existing under and by virtue of the laws of the State of New York, having its principal place of business at Niagara Falls, New York.

3. Prest-O-Lite Storage Battery Corporation, a corporation organized and existing under and by virtue of the laws of the State of Indiana, having its principal place of business at Speedway, Indianapolis, Indiana.

4. Southwest Battery Corporation, a corporation organized and existing under and by virtue of the laws of the State of Delaware, having its principal place of business in Oklahoma City, Oklahoma.

5. U S L Battery Corporation of California, a corporation organized and existing under and by virtue of the laws of the State of California, having its principal place of business at Oakland, California.

6. Wubco Battery Corporation, a corporation organized and existing under and by virtue of the laws of the State of New York having its principal place of business at Niagara Falls, New York.

7. Marko Storage Battery Corporation, a corporation organized and existing under and by virtue of the laws of the State of New York, having its principal place of business in Brooklyn, New York.

20. Before the dates of issuance of the five first mentioned of the foregoing Letters Patents the defendant by and through its agents sought out the plaintiff in Japan and represented that it was interested in his inventions above described, and thereupon requested and was granted by plaintiff Shimadzu and had full access to the manufacturing plant in Japan operating the processes and producing the products embodying his inventions above described, and was given disclosure of all necessary mechanical and chemical details relating to the said processes and products forming the basis of the patent hereinbefore set forth. Defendant thereafter requested the plaintiff Shimadzu to proceed or send a representative to Philadelphia in this District to negotiate with the defendant to further explain and disclose the processes and products covered by the aforementioned patents and particularly the details of the practical commercial operation thereof.

In pursuance thereof one Lyuho S. Ishimura, agent of and representing plaintiff Shimadzu, proceeded to Philadelphia in the year 1926 at the request of defendant and at its request continued to furnish defendant with further data and information covering the practical operation and cost of commercializing the processes and products claimed and set forth in said Letters Patent, the defendant still representing that it was interested in acquiring rights in said inventions.

21. Defendant obtained from said Shimadzu the explanations, information, data and disclosures aforesaid concerning said inventions not for the purpose of acquiring the patents therefor or a license thereunder, but for the purpose of ascertaining and using in its own business the processes and making, using and selling the products covered by the said patents, without compensating said plaintiff Shimadzu, and willfully and fraudulently intending to infringe said patents.

22. In the meantime one Clarence Hall, an employee of the defendant company, had pending in the United States Patent Office an application for making certain lead products and the processes relating thereto, Serial Number 702,889, filed March 29, 1924, allowed February 6, 1926, and which application became forfeited on the sixth day of August, 1926. Thereafter said Hall's application was renewed by or through the action of the defendant on the twenty-fourth day of December, 1926, at which time claims verbatim with the Shimadzu patent aforesaid, No. 1,584,150, were inserted in said Hall application and a new application filed, Serial Number 156,980, containing verbatim certain claims of the plaintiff Shi-

madzu patent No. 1,584,152; whereupon negotiations with said Shimadzu and his representatives were terminated by defendant and two interferences, Numbers 54,798 and 56,224, were declared by the United States Patent Office between said Hall applications and Shimadzu Patents Nos. 1,584,150 and 1,584,152.

23. Testimony was taken by both parties to said interference, the result being a holding in favor of priority of invention for Shimadzu by the Examiner of Interferences in the United States Patent Office August 29, 1929; a decision favorable to Shimadzu before the Board of Appeals in the United States Patent Office November 26, 1930, and a decision on June 20, 1932, in favor of Shimadzu by the Court of Customs and Patent Appeals, Washington, D. C., all of which proceedings were conducted on behalf of said Hall by and on the authority of the defendant.

24. Plaintiff therefore avers that defendant, appropriating and utilizing the aforesaid information and data, and utilizing the aforesaid disclosures of the aforesaid Shimadzu inventions and patents, has willfully and fraudulently infringed the aforesaid patents as hereafter more particularly set forth.

25. That the defendant, The Electric Storage Battery Company, without the license or authority of plaintiffs, and well knowing the premises and the rights secured to the plaintiffs under the said Letters Patent of the United States in suit and each of them but contriving to injure plaintiffs and to deprive them of profits and advantages which otherwise would accrue to them from said inventions, after the granting of said Letters Patent of the United States in suit and each of them as aforesaid, and before the

commencement of this suit and within six years next prior to the filing of this bill of complaint, within this Eastern District of Pennsylvania and elsewhere in the United States, did willfully, fraudulently and unlawfully make, use and sell, and is now making, using and selling and is threatening to continue to make, use and sell the products made in accordance with and embodying the inventions described in and covered by the said Letters Patent of the United States in suit, No. 1,584,150, No. 1,584,149, No. 1,584,151, No. 1,584,152, No. 1,584,479 and No. 1,896,020, and each of them; and before commencement of this suit and within six years next prior to the filing of this Bill of Complainant did willfully, fraudulently and unlawfully practice and is now willfully and unlawfully practicing and is threatening to continue to willfully and unlawfully practice within this Eastern District of Pennsylvania and elsewhere in the United States the processes described in and embodying the inventions embraced, covered and described by said Letters Patent of the United States in suit, No. 1,584,150, No. 1,584,149, No. 1,584,151, No. 1,584,152, No. 1,584,479, No. 1,896,020, and each of them; and willfully and fraudulently did infringe, is infringing and threatening to infringe each of the aforesaid patents within this District and elsewhere in the United States.

26. Defendant was duly notified of its said infringement upon said Letters Patent of the United States in suit.

27. The said defendant has derived and received, and will derive and receive from the aforesaid infringement, gains, profits and advantages, but to what amount the plaintiffs are not informed and can-

not set forth; and the plaintiffs by reason of the aforesaid infringement have been and will be deprived and prevented from receiving, if such infringement is not restrained by this Court, all the gains and profits to which the plaintiffs are lawfully entitled and which they would have derived and received and would now be deriving and receiving but for the aforesaid infringement. By reason of the aforesaid infringement the plaintiffs have been irreparably injured and have sustained great loss and damage thereby; and unless said infringement is enjoined and restrained by an order and writ of injunction issuing out of this Honorable Court, further irreparable injury, loss and damage will be caused to the plaintiffs. Plaintiffs have no adequate remedy at law.

Plaintiffs therefore pray:

(a) That defendant be required to answer this Bill of Complaint, but not under oath, answer under oath being hereby expressly waived.

(b) That this Court decree that plaintiffs' aforesaid Letters Patent of the United States No. 1,584,150, No. 1,584,149, No. 1,584,151, No. 1,584,152, No. 1,584,479 and No. 1,896,020 are good and valid and are owned by the plaintiffs and have been and are being infringed by the defendant.

(c) That this Honorable Court grant a preliminary injunction pending this suit, and a perpetual injunction restraining and enjoining defendant, its officers, agents, employees, associates and confederates, from making and/or using and/or vending the product, and practicing the processes, embodying the patented inventions claimed in the aforesaid Letters Patent and each of them, and from offering or advertising so to do and from aiding or abetting in any

way or in any way contributing to the infringement of said Letters Patent and each of them.

(d) That the defendant be ordered and decreed to deliver to the plaintiffs all infringing apparatus which it has in its possession and/or under its control and/or that such apparatus be destroyed and/or that the same be delivered to this Honorable Court and/or be impounded as to the Court may seem just and proper.

(e) That this cause be referred to a master to make and report an account of damages and profits accruing from defendant's infringement of said patents and that the damages reported be increased threefold in view of the wanton fraudulent and willful character of defendant's infringement; and that plaintiffs have judgment for the damages and profits so found, and for the costs of this suit.

(f) That plaintiffs have such other and further relief as equity may require.

May it please your Honors to grant unto plaintiffs a writ of subpœna issued out of and under the seal of this Honorable Court directed to said defendant, commanding it on a certain day and under a certain penalty to be and appear before this Honorable Court, then and there to answer to this Bill of Complaint and to stand to and abide by such further orders, directions and decrees as may be entered herein.

GENZO SHIMADZU,
By JUNICHI MIYATA,
Attorney in Fact.

NORTHEASTERN ENGINEERING CORPORATION,
By CHARLES B. BISHOP,
President.

HUNT, HILL & BETTS,
120 Broadway,
Borough of Manhattan,
City of New York, N. Y.
and
RAWLE & HENDERSON,
Fifteenth and Chestnut Streets,
City of Philadelphia, Pa.
Solicitors for Complainants.

JOSEPH W. HENDERSON,
GEO. WHITEFIELD BETTS, JR.,
J. T. NEWTON,
Of Counsel.

STATE OF NEW YORK,
CITY AND COUNTY OF NEW YORK,
SOUTHERN DISTRICT OF NEW YORK, } *ss:*

On this tenth day of May, 1933, at the City, County and State of New York, Southern District of New York, before me, a Notary Public in and for the County aforesaid, personally appeared Junichi Miyata, who, being first duly sworn, testified that he is the Attorney-in-Fact in the United States for Genzo Shimadzu, one of the plaintiffs named in the foregoing Bill of Complaint. That he has read and subscribed to the same for and on behalf of said Genzo Shimadzu and that he knows the contents thereof and that the same is true of his own knowledge except as to the matters therein stated to be on information and belief, and, as to those matters, he believes it to be true. That the sources of his information and the grounds of his belief are conversations with the said complainant and documents and papers submitted to

him by said complainant and in his possession pertaining to the matter aforesaid. That the reason this verification is not made by said plaintiff is that he is not now within the United States.

ISABELLE ROSE,
(Seal) *Notary Public.*
New York County No. 153.
New York Registers No. 5R73.
Commission expires March 30, 1935.

(N. Y. County Clerk's Certificate.)

No. 31502 Series D.

STATE OF NEW YORK, }
COUNTY OF NEW YORK, } *ss:*

I, Daniel E. Finn, Clerk of the County of New York, and also Clerk of the Supreme Court for the said County, the same being a Court of Record, having a seal, do hereby certify, That Isabelle Rose, whose name is subscribed to the deposition or certificate of the proof or acknowledgment of the annexed instrument, and thereon written, was, at the time of taking such deposition, or proof and acknowledgment, a Notary Public in and for such County, duly commissioned and sworn and authorized by the laws of said State, to take depositions and to administer oaths to be used in any Court of said State and for general purposes; and also to take acknowledgments and proofs of deeds, of conveyances for land, tenements or hereditaments in said State of New York. And further, that I am well acquainted with the handwriting of such Notary Public and verily believe that

the signature to said deposition or certificate of proof or acknowledgment is genuine.

In Testomony Whereof, I have hereunto set my hand and affixed the seal of the said (Seal) Court and County the twenty-seventh day of May, 1933.

DANIEL E. FINN,
Clerk.

UNITED STATES OF AMERICA,
STATE OF DELAWARE,
COUNTY OF NEW CASTLE, } *ss:*

On this twenty-fifth day of May, 1933, before me personally appeared Charles B. Bishop, who made solemn oath that he is the President of Northeastern Engineering Corporation, the plaintiff corporation in the foregoing Bill of Complaint, and that he has read and subscribed to the same for and in behalf of said corporation; that he knows the contents thereof and that the same is true of his own knowledge, except as to matters and things therein stated to be on information and belief, and that as to those matters he believes it to be true.

AVIS B. BISHOP,
(Seal) *Notary Public.*

(New Castle County Clerk's Certificate.)

STATE OF DELAWARE, } *ss:*
NEW CASTLE COUNTY, }

I, Harvey Hoffecker, Prothonotary of the Superior Court of the State of Delaware, in and for

New Castle County, which Court is a Court of Record, do hereby certify that Avis S. Bishop, before whom the annexed acknowledgment was taken, was at the time of taking such affidavit, affirmation or acknowledgment a Notary Public in the State of Delaware, of the County of New Castle, duly commissioned and sworn, and authorized to take and certify affidavits, affirmations and acknowledgments, and proofs of deeds or conveyance of lands, tenements and hereditaments in the State of Delaware and to all of whose acts as such full faith and credit are, and ought to be given, as well in Courts of Justice as elsewhere.

That I am well acquainted with the handwriting of said Notary Public and verily believe that the signature to said affidavit, affirmation or acknowledgment, purporting to be the signature of the said Avis S. Bishop is genuine.

In Witness Whereof, I hereunto set my hand and affix the seal of the said Superior Court, at Wilmington, this Twenty-fifth (Seal) day of May, in the year of our Lord one thousand nine hundred and thirty-three.

HARVEY HOFFECKER,
Prothonotary.

It is hereby certified that the within is a true and correct copy of the Original Bill of Complaint filed in the above-entitled matter.

JOSEPH W. HENDERSON,
GEO. WHITEFIELD BETTS, JR.,
Of Counsel.

ANSWER
(Filed Oct. 30, 1933.)

To the bill of complaint herein, defendant, The Electric Storage Battery Company, answers as follows:

1. Answering Section 1 of the bill, defendant admits the truth of the allegation.

2. Answering Section 2 of the bill, defendant has no knowledge as to whether or not the Northeastern Engineering Corporation is a corporation of Delaware or is a citizen or has a place of business in Wilmington, Delaware, and therefore denies such allegation.

3. Answering Section 3 of the bill, defendant admits that it is a corporation and a citizen and a resident as therein alleged, but denies that it has committed any infringing acts at the places therein referred to or elsewhere.

4. Answering Section 4 of the bill, defendant admits that this court has jurisdiction.

5. Answering Sections 5 and 6 of the bill, defendant admits that one of the patents in suit, No. 1,584,150 was granted on the 11th day of May, 1926, but is not informed except by the bill of complaint as to the truth of the other allegations there made and therefore denies the same and denies that said patent was duly or properly issued and granted.

6. Answering Sections 7 and 8 of the bill, defendant admits that another of the patents in suit, No. 1,584,149 was granted on the 11th day of May, 1926, but is not informed except by the bill of complaint as

to the truth of the other allegations there made and denies the same and denies that said patent was duly or properly issued and granted, and defendant avers that said letters patent 1,584,149 is void and invalid because the invention therein described and claimed had been patented in Japan on an application filed by the patentee more than twelve months prior to the application upon which said patent, 1,584,149, issued.

7. Answering Sections 9 and 10 of the bill, defendant admits that another of the patents in suit, No. 1,584,151, was granted on the 11th day of May, 1926, but is not informed except by the bill of complaint as to the truth of the allegations there made and therefore denies the same and denies that said patent was duly or properly issued and granted.

8. Answering Sections 11 and 12 of the bill, defendant admits that another patent in suit, No. 1,584,132 was granted on the 11th day of May, 1926, but is not informed except by the bill of complaint as to the truth of the allegations there made and therefore denies the same and denies that said patent was duly or properly issued and granted.

9. Answering Sections 13 and 14 of the bill, defendant admits that another of the patents in suit, No. 1,584,479, was granted on the 11th day of May, 1926, but is not informed except by the bill of complaint as to the truth of the allegations there made and therefore denies the same and denies that said patent was duly or properly issued and granted, and defendant avers that said letters patent 1,584,479, is void and invalid because the invention therein described and claimed had been patented in Japan on an application filed by the patentee more than twelve

months prior to the application upon which said patent, 1,584,479, issued.

10. Answering Sections 15 and 16 of the bill, defendant admits that another of the patents in suit, No. 1,896,020, was granted on the 31st day of June, 1933, but is not informed except by the bill of complaint as to the truth of the allegations there made and therefore denies the same and denies that said patent was duly or properly issued and granted.

11. Answering Section 17 of the bill, defendant is not informed except by the bill as to the truth of the allegation that plaintiff, Northeastern Engineering Corporation, was granted by the plaintiff, Shimadzu, an exclusive license for the whole of the United States, its territories and possessions, in respect to all of the patents in suit, together with the right to license others, and therefore denies the same.

12. Answering Section 18 of the bill, defendant is not informed, except by the bill as to the truth of the allegations to the effect that plaintiff, Shimadzu, has been and is vested with the legal title in and to the six patents in suit, and that plaintiff, Northeastern Engineering Corporation, has been and is vested with an exclusive license under said six patents in suit, and therefore denies the same.

13. Answering Section 19 of the bill, defendant is not informed, except by the bill, as to the truth of the allegation that licenses have been granted to the parties named, and therefore denies the same.

14. Answering Section 20 of the bill, defendant denies that, before the issue of the five patents first

mentioned in the bill or at any time, it by and through agents sought out the plaintiff in Japan and represented that it was interested in plaintiff's inventions; denies that it requested and was granted, by plaintiff Shimadzu, and had full access or any access to any plant in Japan operating the processes or producing the products or any of them referred to in the bill, and denies that it was given disclosure of all or any necessary mechanical and chemical details relating to said processes and products forming the basis of the patents set forth in the bill. Defendant denies that it requested the plaintiff, Shimadzu, to proceed or send a representative to Philadelphia to negotiate with it and to further explain and disclose the processes and products referred to in said patents and the details of the practical commercial operation thereof.

Defendant admits that one Lyuho S. Ishimura, in the year 1926, visited defendant and sought unsuccessfully to interest defendant in the purchase of a license under said five letters patent, and defendant denies each and every allegation contained in Section 20 of the bill.

15. Answering Section 21 of the bill, defendant denies all acts of infringement with which it is charged and denies each and every allegation contained in said Section.

16. Answering Section 22 of the bill, defendant admits the truth of the allegation thereof, except that the renewal of Hall's allowed application was not by or through the action of the defendant and except that application Serial No. 156,980 was filed as a renewal division.

17. Answering Section 23 of the bill, defendant

avers that the result of said proceedings was threefold: First, the issue to Hall on the 22nd day of November, 1932, of patent No. 1,888,823, containing process and product claims presented in his original application filed March 29, 1924, and allowed long prior to Shimadzu's visit in 1926 and long prior to the declaration of said interference and prior to the grant of said five patents to Shimadzu; second, the holding was that certain of the claims of Shimadzu's patents, copied by Hall for the purposes of interference and which Hall believed he had the right to copy and make for the purpose of bringing about an interference, were invalid; and third, Hall, although first in point of time in respect to the subject matter of his application filed in 1924, had no right to make the others of said claims copied from Shimadzu's patent, because these Shimadzu claims involve a specific product not specifically and in terms mentioned by Hall; therefore priority was awarded to Shimadzu in respect to such claims. Otherwise than as above, defendant denies the allegations of Section 23 of the bill.

18. Answering Section 24 of the bill, defendant denies all acts of infringement and denies the appropriation and use of any information, data or disclosure of Shimadzu's alleged inventions, and alleges that it was successfully making, using and selling its product long before it ever heard of Shimadzu or of his alleged inventions and patents.

19. Answering Section 25 of the bill, defendant denies all acts of infringement with which it is charged, but admits that it is practicing the process and making a product described and claimed in U. S. letters patent to Hall, No. 1,888,823, dated November

22, 1932, and which it used commercially and successfully long prior to any date of invention established by Shimadzu in said interference proceedings.

20. Answering Section 26 of the bill, defendant denies that it was duly notified of its alleged infringement upon the patents in suit.

21. Answering Section 27 of the bill, defendant denies that it has derived and received or is deriving or receiving any gains or profits and advantages from any infringement of any of said letters patent and denies all acts of infringement with which it is charged.

22. Defendant avers, on information and belief, that plaintiff, Shimadzu, well knowing that defendant was manufacturing the product and practicing the process now claimed to be an infringement as early as 1926, has delayed for substantially seven years before bringing this suit, and defendant having repeatedly denied infringement and relying upon plaintiff's inaction and believing that its business was legitimate, has expended large sums of money in and about the development of its said business and the construction of a large plant, and that plaintiffs are, by inaction, guilty of laches and are not entitled to the relief prayed for.

23. Defendant avers, on information and belief, that in view of the prior art, it required no invention to produce the said alleged improvements of said patents or any of them because the said improvements at the date of Shimadzu's alleged invention thereof were not patentable invention or improvement within the meaning of the law and not proper subject

matter for letters patent of the United States, and because said Shimadzu was not the original and first inventor or discoverer of the alleged inventions purporting to be covered thereby.

24. Defendant avers, on information and belief, that letters patent No. 1,584,149 are null, void and invalid in view of Japanese patent No. 41728 applied for November 21, 1920, and issued February 13, 1922, to said Shimadzu for Reactive Lead Powder, and Letters patent No. 1,584,479, are null, void and invalid in view of Japanese patent 42,861, applied for August 3, 1921, and issued June 17, 1922, for Process for the Manufacture of Pole Plates of Accumulators, to Shimadzu, and Japanese 42,862, applied for and issued on the same dates, for Pasted Accumulator Plates, to said Shimadzu.

25. Defendant avers, on information and belief, that all of said letters patent are null, void and invalid because all substantial and material parts thereof were described and patented in Japan and other foreign countries by said Shimadzu on applications filed more than one year prior to the filing of the corresponding patents in the United States.

26. Defendant avers, on information and belief, that said letters patent Nos. 1,584,149, 1,584,150, 1,584,479 and 1,584,151, are null, void and invalid in view of the disclosure of all substantial and material parts thereof in Belgian patent 284,885, filed February 4, 1920, issued March 15, 1929, and in the printed publication entitled Brevets deposes en Deuxiene Fascicule, 1920, published early in 1921, by the Belgian patent office in which said Belgian patent 284,885, is digested, and in British patent to Thomas Hyde, No.

19,981 of 1902, and in Elektrotechnische Zeitschrift of Nov. 3, 1893, page 635, in an article by Von C. Liebenow, and in Akkumulatoren Und Galvanischen Elemente by Dr. L. Lucas—1917, published by Max Jaenecke Leipzig, page 24, Paragraph 3, and in "Storage Battery Engineering" 3rd Edition, by Lamar Lyndon, published in New York, 1911 by McGraw Hull Book Company, page 185.

Defendant avers that the claims of said letters patent are invalid and void because the subject matter thereof was, prior to the alleged invention thereof by Shimadzu, and for more than two years prior to his application dates, known to and used by the defendant at Philadelphia, Pennsylvania, and by the Willard Storage Battery Company at Cleveland, Ohio.

27. That the description of the invention in the specification is not in such full, clear, concise, and exact terms as to enable any person skilled in the art or science to which it appertains or with which it is most nearly connected, to make, construct, compound and use the same. This refers to Patent 1,584,150.

28. Defendant avers, on information and belief, that the claims of each of said letters patent are invalid in view of the patents and printed publications set forth in Schedule A, hereto attached and made part hereof.

29. Defendant avers that plaintiff, Shimadzu, having successfully contended in the litigation referred to in Sections 22 and 23 of the bill, that the process and product are different from and do not embody the alleged invention of the Shimadzu patent, 1,584,150, is estopped from alleging infringement thereof in this suit.

Wherefore defendant prays that the bill be dismissed with costs to be allowed to the defendant.

THE ELECTRIC STORAGE BATTERY COMPANY
By JOHN R. WILLIAMS,
President.

(Seal)
Attest

WALTER G. ANDERSON,
Secretary.

Solicitors and of Counsel.
AUGUSTUS B. STOUGHTON,
HUGH MORRIS,
A. F. KWIS,
EDW. S. W. FARNUM, JR.

SCHEDULE A.

JAPANESE PATENTS TO PLAINTIFF, SHIMADZU.

#40,704 — PAINT.

Applied for Dec. 9, 1920
Issued Nov. 18, 1921

#41,728 — REACTIVE LEAD POWDER.

Applied for Nov. 21, 1920
Issued Feb. 13, 1922

#41,953 — MFG. OF LITHARGE BY MEANS OF NATURAL OXIDATION.

Applied for Aug. 29, 1920
Issued March 10, 1922

#42,562 — Addition to 41,728 REACTIVE LEAD POWDER.

Applied for Nov. 27, 1920
Issued May 10, 1922

#42,563 — REACTIVE LEAD POWDER.

Applied for Nov. 27, 1920
Issued May 10, 1922

#42,564 — REACTIVE LEAD POWDER.

Applied for Nov. 27, 1920
Issued May 10, 1922

#45,093 — MANUFACTURE OF ELECTRODES FOR STORAGE BATTERY BY USE OF LEAD SUBOXIDE.

Applied for June 1, 1922
Issued March 31, 1923

#60,825 — LEAD SUBOXIDE POWDER CONTAINING METALLIC LEAD.

Applied for Feb. 3, 1923
Issued June 19, 1924

#42,861 — PROCESS FOR MFG. OF POLE PLATE OF ACCUMULATOR.

Applied for August 3, 1921
Issued June 17, 1922

#42,862 — PASTED ACCUMULATOR PLATE.

Applied for August 3, 1921
Issued June 17, 1922

BRITISH PATENT TO PLAINTIFF, SHIMADZU.

#176,924 — LEAD OXIDES AND PROCESSES TO MANUFACTURE SAME.

Applied for Dec. 20, 1920
Accepted March 23, 1922

#197,031 — IMPROVEMENTS IN METHODS OF MANUFACTURE OF METAL POWDER.

Applied for Feb. 7, 1922
Issued May 7, 1923

#218,119 — METHOD—
POWDER OF LEAD SUBOXIDE INTERMINGLED WITH POWDER OF METALLIC LEAD.

Applied July 18, 1923
Issued July 3, 1924

#236,368 — PROCESS OF MANUFACTURING LEAD OXIDES.

Applied for June 26, 1924
Issued July 9, 1925
Refers to 176,924. 198,647 and 215,222

#263,644 — APPARATUS FOR CONTINUOUS PRODUCTION OF LEAD OXIDES IN THE DRY STATE.

Applied for Jan. 27, 1926
Issued Jan. 6, 1927

BRITISH PATENTS.

Hyde #19,981 — AN IMPROVED METHOD OF AND APPARATUS FOR PULVERIZING METALLIC LEAD, &c.

Applied for Sept. 12, 1902
Accepted May 21, 1903

Coleman #14,794 — IMPROVED PROCESS AND APPARATUS FOR THE MANUFACTURE OF WHITE LEAD, &c.

Applied for Aug. 16, 1892
Accepted Sept. 24, 1892

BISCHOF #13,202 — IMPROVEMENTS IN APPARATUS FOR REDUCING LITHARGE AND OTHER LEAD OXIDES TO SUBOXIDES.

1898

UNITED STATES PATENTS.

BAILEY #846,384 — LEAD PRODUCT.
Applied for June 26, 1902
Issued March 5, 1907

THIBAULT #846,444 — PROCESS OF MAKING METALLIC OXIDES.
March 12, 1907

THIBAULT #1,482,327 — PRODUCTION OF METAL OXIDES, ESPECIALLY LEAD OXIDES.
Applied for January 5, 1920
Issued January 29, 1924

HALL #1,888,823 — LEAD OXIDE POWDER AND METHOD OF MAKING THE SAME.
Applied for March 29, 1924
Renewed December 24, 1926
Issued November 22, 1932

HALL #1,675,345 — APPARATUS FOR MAKING LEADEN POWDER.
Applied March 29, 1924
Issued July 3, 1928

HARDINGE #1,450,289 — APPARATUS FOR ENTRAINING AND REMOVING FINES FROM CONICAL MILLS.
Filed April 29, 1920
Issued April 3, 1923

HUFFARD & HAYNES #1,491,237 — PROCESS AND APPARATUS FOR OXIDIZING LEAD.

PETERS =1,441,168 — PAINT COMPOSITION AND PROCESS OF MANUFACTURING THE SAME.

JANUARY 2, 1923

MARTIN =207,264 — SUBOXIDE IN PAINT.
Applied November 16, 1877
Issued August 27, 1878

FULLMAN =1,174,975 — TUMBLING BARREL.
March 14, 1916

WEBSTER & GIBBS =406,378 — APPARATUS FOR COMMINUTING AND CORRODING LEAD.

July 2, 1889

HOLLEY =1,123,743 — PROCESS OF MAKING PIGMENTS.

January 5, 1915

FRENCH PATENT.

Jacques Antoine Thibault — GRINDING LEAD BALLS IN A MILL.
Issued Sept. 4, 1919 =494,270.

BELGIAN PATENT.

=284,885 — MECHANICAL METHOD OF MAKING POWDER FROM LEAD OR LITHARGE AND OTHER OXIDES OF LEAD, TO STE. ANNE ACCUMULATEURS TUDOR a BRUXELLES.

Applied for February 4, 1920
Issued March 15, 1920

PRINTED PUBLICATION.

Brevets déposés en	Brevetten neergelegd in 1920.
Deuxieme Fascicule	Tweede Aflevering

E.—INDUSTRIES CHIMIQUES. SCHEIKUNDIGE BEDRIJVEN

ACCUMULATEURS TUDOR, société anonyme, 79, rue Joseph II, á Bruxelles.

UNITED STATES PATENTS.

Wm. L. Silvey #645,978 — SECONDARY BATTERY.
March 27, 1900

E. A. Sperry #723,327 — IMPROVEMENTS IN STORAGE BATTERIES.
Applied for August 12, 1901
Issued March 24, 1903

NOTICE OF MOTION FOR LEAVE TO AMEND ANSWER.

(Filed June 8, 1935.)

Please take notice that on Wednesday, the 12th day of June, 1935, at Ten O'clock in the forenoon, or as soon thereafter as counsel can be heard, at the United States District Court for the Eastern District of Pennsylvania, at the Post Office Building, 9th & Chestnut Streets, City of Philadelphia, State of Pennsylvania, the attached amended answer will be presented and the court will be asked for leave to file it.

E. S. W. Farnum, Jr.,
Augustus B. Stoughton,
Hugh M. Morris,
Solicitors and of Counsel for Defendant.

To:

Joseph Henderson, Esq.,
Rawle & Henderson,
Packard Building,
Phila., Pa.,
Solicitors and of Counsel for Plaintiffs.

AMENDED ANSWER.

Now comes The Electric Storage Battery Company, defendant herein, and by leave of court first had and obtained, amends its answer as follows:

By adding immediately after paragraph 29 on page 9, of its printed answer the following paragraph:

30. Defendant avers that the said Letters Patent No. 1,584,150, to Shimadzu are void for unreasonable neglect or delay in disclaiming claims 9 to 13 thereof, inclusive, covering subject matter which Shimadzu was not the original or first inventor or discoverer, and, therefore, invalid, and held to be unpatentable over the patent No. 1,482,327, of January 29, 1924, to J. A. Thibault, for Production of Metal Oxides, Especially Lead Oxides, by the Law Examiner of the Patent Office under date of February 18, 1928, in Interference Hall vs. Shimadzu, No. 54,798. Record U. S. Court of Customs and Patent Appeals, Nos. 2982, and 2983, page 200.

E. S. W. Farnum, Jr.,
Augustus B. Stoughton,
Hugh M. Morris,
Solicitors and of Counsel for The Electric Storage Battery Company.

Dated June 7, 1935.

NOTICE OF MOTION.

(Filed Dec. 19, 1933.)

Please take notice that we shall present the accompanying motion before the United States District Court at the United States Post Office Building in the City of Philadelphia, Pennsylvania, on the day of November, 1933, at 10 A. M., or as soon thereafter as counsel can be heard.

Dated, November 16, 1933.

Yours, etc.,

JOSEPH HENDERSON,
RAWLE & HENDERSON,
Solicitors for Plaintiff,
Office & P. O. Address:
Packard Building,
Fifteenth and Chestnut Streets,
Philadelphia, Pa.

HUNT, HILL & BETTS,
Solicitors for Plaintiff.
Office & P. O. Address:
120 Broadway,
Borough of Manhattan,
New York, N. Y.

To:
AUGUSTUS B. STOUGHTON,
EDWARD S. W. FARNUM, JR., Esqrs.,
Solicitors for Defendant.

MOTION.
(Filed Dec. 19, 1933.)

Now come the plaintiffs, Genzo Shimadzu and Northeastern Engineering Corporation, plaintiffs, by their attorneys, and upon the pleadings and proceedings herein and upon the annexed affidavit of James T. Newton, verified the 13th day of November, 1933, move the court for an order permitting plaintiffs' representatives, counsel and qualified experts to inspect the defendant's plant, to observe the apparatus used and the method employed by defendant in its manufacture from raw lead of its products, including those for use with paints and for storage batteries

manufactured and sold by it, said order to provide for:—

(1) the furnishing to plaintiffs ten days before the time of said inspection of complete dimensional elevation and plan drawings to scale, showing internal, as well as external, construction of defendant's apparatus, including lead feeding and product collecting equipment, said drawings to indicate clearly and accurately the location and nature of every indicating and recording instrument or device used in connection with the operation of the apparatus, a separate set of drawings to be furnished for each different type of apparatus employed by defendant.

(2) the furnishing to plaintiffs for examination ten days before the time of said inspection of one freshly made normal two-pound sample of material, freshly obtained from each discharge point of the apparatus, and labelled to identify for plaintiffs its point of discharge, properly sealed for preservation, samples to represent each product manufactured in each different type of apparatus employed by defendant.

(3) the making available to plaintiffs of all records of operating data and product analysis for a period beginning two years before filing of the bill herein up to and including the period of inspection of defendant's apparatus by plaintiffs, such records to remain available to plaintiffs until completion of the trial.

(4) the furnishing to plaintiffs ten days before the time of said inspection a battery manufactured in accordance with the process and with the products used by defendant in its regular business as em-

ployed by it within three months of the filing of the bill of complaint herein.

(5) said inspection to include the observation of the normal use of the apparatus employed by defendant and the methods employed by it, together with the observation of customary engineering tests to be made in the presence of plaintiffs' experts and representatives with the defendant's apparatus, when conducted by the defendant in its regular method of operating the apparatus substantially identical to that employed by it in the production of the battery referred to above; including the starting of a freshly cleaned apparatus with a fresh charge of metallic lead, together with any other constituents, normally employed in starting the operation of the apparatus, running the same until the apparatus has come up to normal operation and thereafter continuing such operation for a period of from one to two days under normal operating conditions; taking the temperatures and all pertinent readings such as the speed of revolutions of the apparatus, amount of air employed, the load, amount of water and or steam used inside or outside of the apparatus, etc., etc.; also permitting plaintiffs to take any samples they may desire at any time during said tests and upon termination thereof, to cause the apparatus to be stopped and immediately to take samples of the contents of the apparatus and to inspect the interior of the apparatus; and that the instruments employed in the test observed by plaintiffs be calibrated both before and after said tests by a competent concern to be agreed upon by the parties or designated by this Honorable Court; the production of all the sheets of all recording instruments used during said tests, together with corresponding

data sheets normally used by defendant in the conduct of its business to be lodged with the Clerk of the Court for use at the trial.

JOSEPH HENDERSON,
RAWLE & HENDERSON,
Solicitors for Plaintiffs.
Office & P. O. Address:
Fifteenth & Chestnut Streets,
Philadelphia, Pa.

HUNT, HILL & BETTS,
Solicitors for Plaintiffs.
Office & P. O. Address:
120 Broadway,
New York, N. Y.

Dated: November 16, 1933.

DISTRICT OF COLUMBIA }
CITY OF WASHINGTON } *ss:*

I, James T. Newton, being duly sworn, doth depose and say that I am of mature age and reside at 1625 R Street, N. W., Washington, D. C. I am a Patent Attorney and Patent Expert and have an office in the National Press Building, Washington, D. C. After graduating with the Degree of Bachelor of Engineering, I took the U. S. Patent Office entrance examination and was appointed to the Patent Office in 1891 as an Assistant Examiner. I passed through the various grades of Examiner, member of the Board of Appeals, Assistant Commissioner of Patents and resigned after three years service as Commissioner of Patents, in July, 1920. Since that time I have been engaged in the prosecution of applications for pat-

cuits and in expefting patent cases before the Federal Courts of this Country.

I have read over and understand the Shimadzu patents Nos. 1,584,149-150-151,152, 1,584,479 and 1,896,020, involved in this suit, and I believe I know what those patents cover.

I was engaged in my professional capacity from 1927 to 1933 in the prosecution of two interferences in the United States Patent Office, Hall v. Shimadzu, Nos. 54,798 and 56,224, which were instituted pursuant to the request of the party Hall, the party Hall being an employee of the defendant herein. The inventions involved in those contests, together with others, are involved in the present suit, Shimadzu and Northeastern Engineering Corporation v. The Electric Storage Battery Co.

The interferences referred to passed through the regular proceeding to a decision by the Examiner of Interferences, by the Board of Appeals in the United States Patent Office upon an appeal to that Tribunal and thereupon by the Court of Customs and Patent Appeals, Washington, D. C., all Tribunals deciding in favor of the party Shimadzu, the plaintiff herein.

It was the contention of said Hall and other employees of the Electric Storage Battery Coompany that the machines in operation at the factory of the Electric Storage Battery Company did produce a product substantially identical with that disclosed and claimed in the Shimadzu patents involved in this suit and that the process employed likewise was similar to the processes of the Shimadzu patents.

It is my opinion, therefore, that The Electric Storage Battery Co., by its employees who testified in the Hall v. Shimadzu interference proceedings, gave ample reasons to cause the belief that the Electric Storage Battery Company was and is infringing the afore-

said Shimadzu patents, as was alleged in plaintiffs' bill of complaint herein.

However, in the opinion of deponent, more detailed and accurate information is necessary to plaintiff in order to properly make out this cause of action against defendant and to this end the exact apparatus used by defendant, the particular and precise process or steps used and employed by defendant in producing this product and the exact physical and chemical properties of the product are facts within the knowledge of the defendant, which, however, are not available to plaintiff because of the fact that the product produced is not a product which may be obtained on the market nor, of course, is there any way of ascertaining the exact and precise steps of the process employed by defendant without an actual inspection and the observation of tests conducted upon the apparatus employed by defendant in its plant at Philadelphia.

Further deponent saith not.

Subscribed and sworn to
before he this 13th day of JAMES T. NEWTON.
November, 1933.

CATHARINE S. WILTON,
(Seal) *Notary Public, D. C.*

AFFIDAVIT OF LUYHO S. ISHIMURA.
(Filed Dec. 19, 1933.)

CITY, COUNTY AND STATE OF NEW YORK) ss:
SOUTHERN DISTRICT OF NEW YORK)

Luyho S. Ishimura, being duly sworn, deposes and says:

I am of mature age and an engineer by profession sojourning presently in the City, County and State of New York. After obtaining technical training in Japan I came to this country as a special Government student to continue my studies and graduated from the Polytechnic Institute of Brooklyn in 1916, with the degree of Mechanical Engineer. I then returned to Japan and entered into the employ of the plaintiff Shimadzu herein at Kyoto, Japan, in 1917, and have since been engaged with him in the development of the manufacture of lead oxides and of the patents in suit, and in the storage battery industry.

During February, 1926, one C. Reed Cary, then Vice-President of Leeds & Northrup Company of Philadelphia, Pennsylvania, visited Japan and began to negotiate with the Shimadzu Manufacturing Company, of which the plaintiff Shimadzu is the President, for the establishment of a Japanese agency of the Leeds & Northrup Company to handle the sales of its products. At this time, the plaintiff Shimadzu spoke to said Cary about his new inventions dealing with lead oxide and suboxide products and expressed his desire to interest parties in the United States to acquire rights under his American applications. To this said Cary gave a very promising reply and stated that he could possibly interest one of the largest storage battery companies in the United States, and began to enquire into the processes and operating data and products of the Shimadzu inventions, and was shown through the Shimadzu plants in Kyoto, Japan. Said Cary represented and stated that, although he was connected with the Leeds & Northrup Company, he had very close connections with the Electric Storage Battery Company (defendant herein), and shortly thereafter returned to this country with literature

and various disclosures and data relating to said inventions submitted by said Shimadzu. All the foregoing was reported to me in full by the said Shimadzu and his engineers who were present at the Cary-Shimadzu negotiations, was subsequently confirmed to me personally by officials of said Electric Storage Battery Company, and is a true statement of facts, to the best of my knowledge and belief.

When said Cary returned to the United States he transmitted the results of his observations and his negotiations and the data he had obtained, to the Electric Storage Battery Company, resulting in the latter's request to plaintiff Shimadzu to send his representative to Philadelphia to negotiate for the license and/or sale of the Shimadzu inventions, which are the subject of this suit.

I was selected to represent the plaintiff Shimadzu in said negotiations, and proceeded to Philadelphia, Pennsylvania, and in May, 1926, entered into conversations and negotiations in respect of said inventions with several representatives of The Electric Storage Battery Company, among whom were one Herbert Lloyd, President of said Company, one Edward W. Smith, its factory engineer, one Clarence A. Hall, its Chief Engineer, and Augustus B. Stoughton, Esq., counsel for defendant in this suit. Such representatives of The Electric Storage Battery Company stated to me that that Company was interested in the inventions and wanted to acquire rights under the said Shimadzu patents covering same, and requested me to disclose to them commercial operating and other technical data in respect thereof.

In response to said requests, and relying upon said statements, I furnished said representatives with full information and data relative to said Shimadzu

inventions. A contract for the sale of the Shimadzu patents to said Electric Storage Battery Company was drafted and submitted to said Lloyd, President of The Electric Storage Battery Company, all of which information, data and contract draft they have and still retain.

During August, 1926, when I visited J. R. Williams, Second Vice-President of the defendant herein. I learned to my surprise that both Mr. Lloyd and Mr. Stoughton had gone to Europe on their vacations and that nothing could be decided upon until Mr. Lloyd's return. As they had not indicated any intention of terminating the negotiations I returned to Japan to take up the matter further with Mr. Shimadzu personally, with the intention of coming back to this country.

In the meantime, while these negotiations and disclosures were going on, one Clarence A. Hall, Chief Engineer of The Electric Storage Battery Company, had pending in the United States Patent Office an application for making certain lead products and processes relating thereto, bearing Serial Number 720,889, filed March 20, 1924, allowed February 6, 1926, and which application became forfeited on August 6, 1926. On December 26, 1926, and subsequent to said disclosures and during said negotiations above mentioned said Hall renewed his forfeited application and filed other applications at this time incorporating therein certain claims taken verbatim from the United States Shimadzu Patent #1,584,150 and also from certain claims of the United States Shimadzu Patent #1,584,152. Thereupon said Hall, under the directions and authority of the said The Electric Storage Battery Company and at its expense, unexpectedly caused to be instituted in the

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United States Patent Office in January, 1927, two interferences, Numbers 54 798 and 56,224, between the said Hall applications and the Shimadzu patents.

I was in the United States during the entire pendency of said interferences, served as a witness for the plaintiff Shimadzu, and as an expert advisor to counsel representing said Shimadzu therein. I was present when all depositions for both parties to said interferences were taken, and was in attendance at all hearings held in connection therewith.

Testimony was taken by both parties to the interferences. Hall and other employes of said The Electric Storage Battery Company who testified on its behalf repeatedly admitted that the said Company was manufacturing the products disclosed and claimed in said Shimadzu patents. All the tribunals of the United States Patent Office, as well as the Court of Customs and Patent Appeals, rendered decisions in favor of the plaintiff Shimadzu herein and awarded priority to Shimadzu. The Court of Customs and Patent Appeals rendered its decision on June 20, 1932, affirming the decisions of the tribunals below that said Hall was not entitled to the claim incorporated as aforesaid in his applications and that Shimadzu was the first inventor of said inventions in issue.

From the foregoing facts and other facts relating to the details of the various contacts had from time to time between representatives of plaintiff Shimadzu and representatives of The Electric Storage Battery Company, deponent submits that there is clear ground to believe that The Electric Storage Battery Company and its representatives and employes procured the aforesaid disclosures and operating data from the plaintiff Shimadzu in the manner above

stated under the guise of an intent to acquire rights under the said Shimadzu inventions and patents, and have been and now are wrongfully utilizing and appropriating the same, together with the said Shimadzu inventions to the advantage of said The Electric Storage Battery Company.

Moreover, the inventions and processes involved in this suit are highly technical and complicated. The products from metallic lead obtained by these inventions cannot be purchased or procured in the open market, and the chemical elements and changes, operating conditions, the degree of oxidation, etc. of the metallic lead, among other elements, are so peculiarly minute and difficult of scientific ascertainment that the clearest and only satisfactory method of furnishing these details is by actual inspection and observation of the plant and apparatus of the defendant operating under normal conditions, and careful analysis of samples of the product or products thereof taken in such a manner as to preclude the possibility of physical and/or chemical changes occurring during the interim between their manufacture and the time they are analyzed.

Furthermore, from my long association and study of the art involved in this suit and of said Hall patent and my knowledge of the plaintiff Shimadzu's patents and information given by employes of The Electric Storage Battery Company, I can safely state that the processes and methods employed and the product obtained by the defendant are substantially identical with the inventions of the plaintiff Shimadzu described and claimed in his said patents in suit. The defendant's witnesses and employees in the

interference proceedings repeatedly admitted and testified that such was the fact.

Sworn to before me this
11th day of December, 1933. LUYHO S. ISHIMURA.

ISABEL W. BONNER,
(Seal) *Notary Public.*
New York Co. No. 244.
Register's Office No. 48242.
Commission Expires Mar. 30, 1934.

ANSWER TO MOTION AND AFFIDAVITS.
(Filed Jan. 30, 1934.)

Defendant answering Plaintiffs' Motion says:

1. Plaintiff is a competitor of Defendant. Defendant is the largest manufacturer of storage batteries in the world, and is the oldest manufacturer of storage batteries in the United States, having been continuously engaged therein since 1888.

Plaintiff has licensed manufacturers of storage batteries engaged in competition with the Defendant, as appears by paragraph 19 of the Bill of Complaint, and plaintiff, Shimadzu, is directly or indirectly engaged or interested in manufacturing storage batteries in Japan, as appears by paragraph 20 of the Bill of Complaint.

The Plaintiff, Northeastern Enginering Corporation, is a licensee of the Plaintiff, Shimadzu, and other licensees of the plaintiff are set out in paragraph 20 of the Bill of Complaint.

Of said licensees the U-S-L Battery Corporation is extensively engaged in the manufacture and sale of

storage batteries and is one of the principal competitors of Defendant.

The remaining licensees of the Plaintiff Shimadzu, so far as enumerated in paragraph 19 of the Bill of Complaint, with the exception of Plaintiff, Northeastern Engineering Corporation, are affiliated with the U-S-L Battery Corporation.

PARAGRAPH 2.

During the long period of existence of Defendant it has been engaged not only in the manufacture of storage batteries, but as well in the manufacture of storage batteries of the highest quality in the most efficient manner. To bring about that result Defendant has been constantly engaged, with a great degree of success, in endeavoring to manufacture the highest possible grade of produce with a maximum of efficiency and minimum cost. In such endeavor Defendant has from time to time improved the design, construction and physical combination of the various instrumentalities entering into the operation of the plant to produce a continuous uninterrupted sequence of operation.

The result of the Defendant's continuous effort through the years has been not only a product of the highest grade of quality but a plant set-up and arrangement of the highest efficiency which has enabled Defendant to manufacture its product at a much less cost than it could otherwise do. This result of Defendant's expenditure and effort is an asset of Defendant of great value which it should not be called upon to supply to its competitors without cost or otherwise unless such disclosure be shown to be indispensable to the proper determination of the cause by the Court.

PARAGRAPH 3.

Plaintiffs have not shown that they are entitled to obtain by means of this motion or otherwise the aforesaid valuable asset of this Defendant. Nor have Plaintiffs shown any right whatsoever or any ground upon which they may properly obtain an inspection of Defendant's plant or have Defendant supply to them the information and materials which they seek.

Lead oxide powder for making plates for storage batteries and the process by which it is made, first came to the attention of the Defendant in the summer of 1907, during the presence in Germany of one of its engineers. At that time little if anything was known about lead oxide powder in this country and its use in the battery business.

During 1908 the Accumulatoren-Fabrik Aktiengesellschaft, Hagen, Westphalia, Germany, sent to Defendant a large size sample of lead oxide powder with which a number of plates were pasted and the plates were tested by the Defendant.

In 1909 a second importation of German lead oxide powder was made and a further lot of plates pasted. Some of the plates were pasted in Germany and some in this country.

Subsequently in 1912 and 1913 an engineer of Defendant paid a visit to Germany and obtained very full details of the working of this process and of the employment of the resulting lead oxide powder in making storage battery plates.

The defendant in this suit then had and now has an agreement with The Accumulatoren-Fabrik Aktiengesellschaft, for the exchange of engineering information.

The lead oxide powder gave such satisfactory results that in 1915 the defendant put up in Philadel-

phia, a mill similar to mills used by the Accumulatoren-Fabrik Aktiengesellschaft for the manufacture of the material, and this mill fas completed during 1916.

Operation of this mill was commenced in 1916 and large numbers of plates were made by Defendant from the resulting lead oxide powder.

The experience with plates made from this lead oxide powder was so successful that late in 1916, twenty batteries were sold to the New York Railways Company and put into operation. This initial order was followed later on by another set of plates going to the same company made with this same lead oxide powder, and they were put into operation in 1918. The magnitude of this operation can be gathered from the fact that these batteries contained approximately 19,000 plates made of this lead oxide powder.

Further the defendant installed a larger lead oxide powder plant which was finished and put into operation early in January, 1921. During its operations from 1921 to 1923 the defendant produced approximately three and one half millions lbs. of lead oxide powder.

The mill so employed in 1921 is illustrated and described in patent No. 1,675,345, and the process and product are described in patent No. 1,888,823, both to C. A. Hall.

The product made by the Defendant in 1921, is the same as the product made by it at the present time, and the process and apparatus employed are identical.

The product made by the German Company since 1907 and imported into this country, and made in this country by defendant beginning in 1916, and the product made in this country since 1921 and now made

by defendant, are substantially identical. Storage battery plates made of the two products are identical in all substantial and material respects.

Before defendant first learned of Shimadzu or had brought to its attention or to the attention of any of its engineers or employees, patents or any other publications for which Shimadzu was responsible, defendant had made and used in storage batteries of its manufacture over 10,000,000 lbs. of lead oxide powder made by substantially the same process as that now employed by defendant. (See Paragraph 18 of defendant's answer.).

2. The suit is without probable cause and no prima facie case of infringement has been made.

(a) In interference litigation between Hall and Shimadzu involving some of the same subject matter at the present suit at page 223 of the printed record, submitted herewith, the Board of Appeals on Nov. 26, 1930, found as follows: "We consider that Hall's testimony as corroborated by Shaw and Exhibit No. 1 established that Hall operated a Hardinge mill to produce the powder as variously described by the witnesses early in 1921."

The United States Court of Customs and Patent Appeals, 59 Fed. Rep. (2nd) p. 225, affirmed the decision of the Board.

Hall's date for manufacturing the lead oxide powder thus established, early in 1921, is more than two years before Shimadzu filed his application for a patent in July of 1923.

The United States Court of Customs and Patent Appeals by its decision decided that the process and product of Hall, dating from early in 1921, were not the same but were different from Shimadzu's inven-

tion involved in the interference and that by reason of this difference Hall was not entitled to make Shimadzu's claims. According to the practice in such cases, priority was awarded to Shimadzu and, by reason of this holding and of the fact that Hall was prior in point of time with his lead oxide powder and process, there was issued to Hall on November 22, 1932, Patent No. 1,888,823, containing process and product claims which he presented in his original application filed March 29, 1924. All this is set up in Paragraph 17 of Defendant's Answer.

(b) Defendant in no way conceals its process and product and in Paragraph 19 of its Answer states that it is practicing the process and making the product described and claimed in its Patent No. 1,888 823, and which it has used commercially and successfully long prior to any date of invention established by Shimadzu in the interference proceedings.

(c) In the interference proceedings Shimadzu was held to his filing date of July 1923, and Hall was given a date for his process and product early in 1921. Hall's patent No. 1,888,823, shows the character of apparatus employed and it was established in the interference that it was a Hardinge mill which is a well known apparatus shown in Letters Patent No. 1,450,289, of April 3, 1923.

(d) Of the Patents in suit No. 1,584,479, is void on Japanese patent No. 42,861, both to Shimadzu.

No. 1,584,149, is void on Japanese patents 41,728, and 42,563, both to Shimadzu.

No. 1,584,150 is void on 41,728 and 42,563, both to Shimadzu and also on British patent No. 197,031.

The reason is that the Japanese patents issued prior to the United States patents on applications filed in Japan more than one year prior to the date of

filing of the United States applications. Rev. Stat., sec. 4887. 35 U. S. C. 32.

(e) Certain claims of Patent No. 1,584,150, in suit were held invalid by the Law Examiner in the Patent Office in view of a prior patent to Thibault No. 1,482,327, Record of the interference proceedings, page 200. The claims in question so held invalid are 8 and 10 to 14.

(f) Patent No. 1,584,152 in suit relates to paint. Defendant has not since 1926 made any paint containing lead oxide powder, and prior to 1926 made a small quantity of such paint for experimental purposes only.

(g) There are 43 claims in the patents in suit and although requested so to do, the plaintiffs have refused to state which of the claims they will rely upon.

REQUESTS OR INTERROGATORIES OF THE MOTION.

Plaintiffs ask Defendant what process and apparatus it uses and product it makes. Plaintiffs do not ask Defendant if it is using certain things set forth in its patent.

Request 1 asks detailed information of external and internal construction of Defendant's apparatus, including auxiliary appliances, and asks for drawings to indicate the location of recording instruments not for one apparatus but for every type of apparatus. The request is in no way limited but is directed to all of Defendant's apparatus.

Request 2 asks for freshly made samples of material without specifying in any way what kind of material other than to say each product manufactured

in each different type of apparatus employed by the Defendant.

Request 3 asks for all record and operating data and product analyses for the last four years; again without specifying in any way to what they relate.

Request 4 calls for a battery manufactured in accordance with any process or any product that the Defendant may use and like the other requests has no reference to any patent or patents.

Request 5 asks for an inspection of everything that the Defendant does, together with specially conducted tests involving the calibration of instruments and many other special conditions.

Preceding these itemized requests the Plaintiff wants to observe the apparatus and methods employed by the Defendant in its manufacture beginning with metallic lead and ending with paints and complete batteries.

This fishing expedition is supported by the affidavit of one of Plaintiffs' counsel, and by Ishimura.

ARGUMENT IN SUPPORT OF ANSWER.

In Sinclair Refining Co. v. Jenkins Petroleum Process Co., Advance Reports, Vol. 77, No. 14, 1932 Term, page 900, the Supreme Court was considering the question of inspection of drawings and designs of a bill for discovery of damages filed in aid of an action at law. While the procedure differs from the present procedure we submit that the question involved is the same. The Supreme Court said:

> "To hold that the plaintiff in an action at law may have discovery of damages is not to say that the remedy will be granted as of course; or that protection will not be given to his adversary against impertinent intrusion. Wigram, supra, Par. 115. The Court may decline to open the de-

fendant's records to the scrutiny of a competitor posing as a suitor, if the suit has been begun without probable cause or as an instrument of malice."

* * * * * * * * *

"Only the most general facts are to be discovered in advance of trial."

* * * * * * * * *

The Court refers to "cases where inspection during the trial and in the presence of the jury will produce delay or inconvenience."

* * * * * * * * *

We submit that the present motion is an impertinent intrusion of a competitor posing as a suitor and that the suit is begun without pobable cause as an instrument of malice in the sense of a design of doing mischief to the Defendant. As such, under the Rule announced by the Supreme Court, the Plaintiff is not entitled to inspection.

In Eibel Process Co. v. Remington-Martin Co., 197 Fed. Rep. page 760, the District Court, N. D., N. Y., held that suspicion of infringement is not enough to justify an order of inspection and production. Also that a prima facie case should be made by taking testimony, we presume that a prima facie case of infringement is referred to, and that concealment by the Defendant is necessary to justify an inspection.

In Gasoline Products Co., Inc. v. American Refining Co., 12 Fed. Rep. (2nd) page 98, D. C., Del., it was held that in the case of a license the plaintiff may ask the Defendant if it is using some defined apparatus but cannot ask broadly and generally what apparatus Defendant is using.

In the last case reference is made to New Jersey Zinc Co. v. Du Pont De Nemours & Co., Inc., 11 Fed.

Rep. (2nd) page 908, in which the District Court of Delaware held that in a patent case the plaintiff may not ask what structure, process and the like the Defendant is using.

On the face of the papers the only attempt to meet the requirement, that where a plaintiff seeks an order of inspection he must show probable cause or a prima facie case of infringement, is the allegation in the affidavit of one of plaintiffs' counsel, and in the affidavit of Ishimura, and analyzed they amount to this: In the interference proceedings Hall contended that the subject matter of his application for a patent included the subject matter of the claims of some of Shimadzu's patents here in suit and his witnesses supported that contention. However, the decision of the Court of Customs and Patent Appeals is that the subject matter of Shimadzu's claims and the subject matter of Hall's application, which resulted in the patent under which the Defendant has operated and is operating since 1921, are different and not the same. Nevertheless in the supporting affidavits the only thing alleged to show probable cause or a prima facie case of infringement is that Hall's witnesses stated that the subject matter of Hall and Shimadzu was the same. Inasmuch as the decision of the Court of Customs and Patent Appeals was to the effect that Hall's witnesses were wrong and the subject matter of the two parties was in fact different, it is impossible to understand how Plaintiffs can imagine that the testimony of Hall's witnesses establishes a prima facie case of infringement or probable cause. At the present time the law of the case is that the subject matter of the application, now patent, of Hall and the patent to Shimadzu are for different subject matter which certainly establishes non-infringement. Again Shimadzu having successfully contended that the sub-

ject matter of Hall's application, now patent, and the subject matter of Shimadzu's patent are not the same and obtained an affirmance of a judgment to that effect, is estopped from making the present contention. In a general way section 17 of Defendant's Answer states these facts and section 29 of the Answer sets up this estoppel.

It has been shown that plaintiff is a competitor posing as a suitor and that the suit is begun without probable cause as an instrument of malice, in the sense of a design of doing mischief to the defendant, and we may add as an instrument of doing the plaintiff great commercial gain. For Plaintiff to obtain full and detailed information of all Defendant's doings, from raw lead to finished product, as requested, would put Plaintiff in a position to duplicate the Defendant's manufacture in Japan with cheap labor, thereby doing Defendant serious mischief, and further would enable Plaintiff to give such information to Defendant's competitors in the United States and elsewhere as an inducement to take licenses under Plaintiffs' patents, with the advantages of defendant's improved design, construction and physical combination of instrumentalities comprising a plant for the practice of a continuous, uninterrupted sequence of operation, and with the advantage of automatic and other machinery and appliances devised by defendant and in no way related to or connected with plaintiffs' patents or any of them.

This Court is asked to take from defendant and give to plaintiff and others of defendant's competitors its valuable, though intangible property, without a shadow of right in the plaintiff. This amounts to the taking of property without due process of law, and also to the taking of private property for private use.

To grant this motion would enable anyone to purchase a patent for perhaps a nominal price and by suing a competitor for infringement obtain a key that would unlock the competitor's factory and records and drawings to the suitor who could by this unlawful inquisition gather into his Abraham-like bosom all of the intangible property of the competitor. This statement is believed to be its own answer.

It is submitted that the motion should be dismissed.

HUGH M. MORRIS,
A. F. KWIS,
AUGUSTUS B. STOUGHTON,
for Defendant.

STATE OF PENNSYLVANIA }
COUNTY OF PHILADELPHIA } *ss.*

John R. Williams, being duly sworn according to law deposes and says:

"I am of mature age and have since the 15th day of May, 1928, been President of the defendant Company, and prior to that time for twenty-eight years I was Vice-President of the defendant Company. I have read the paper entitled "Answer to Motion" in this case, and I understand the same, and the facts set forth in said Motion are true, to the best of my knowledge and belief.

The U-S-L Battery Company is a large manufacturer of storage batteries and competes with the Defendant in the storage battery business. The companies named in Paragraph 19 in the Bill of Complaint, except the Northeastern Engineering Corporation, are affiliated with the U-S-L Battery Corpora-

tion. The Defendant has been engaged continuously in the battery business since 1888, and during that entire time has always applied itself to manufacturing storage batteries of the highest attainable standard of quality, and maintains a chemical and electrical laboratory employing a staff of highly trained chemists and engineers to the end that the manufacturing is conducted in a very efficient manner. Under the direction, or with the cooperation of, this large and capable technical staff, the layout of the plant, the machinery and methods employed, and the technique of the manufacturing operations have been developed and improved and made efficient to a high degree of specialization adapted to produce a high class product. The set-up and arrangement of the Defendant's plant is an exceedingly valuable asset in that it reduces or minimizes the cost and insures uniformity of product. These methods and arrangements have resulted from a very large expenditure of money as well as the application of unusual abilities and are of great value to the defendant who submits that no competitors of the Company should be given access to or by inspection obtain the benefit of this time and work and expense and thus cause the Defendant a very substantial injury and loss. Since 1895 and for a very substantial consideration the Defendant has had an agreement with the Accumulatoren-Fabrik Aktiengesellschaft, a German corporation, the largest manufacturers of storage batteries in Continental Europe, whereby engineering and technical information and new developments are exchanged between the two companies.

I have met Mr. C. Reed Cary, of Philadelphia, Pennsylvania, but know him very slightly. He is now and for some years last past has been a officer of Leeds and Northrup Company, of Philadelphia. Mr.

Cary is not now and never has been employed by the Defendant in any capacity whatever. In 1926 Mr. Cary, entirely on his own motion, and as he said at the request of Plaintiff, brought to the attention of the Defendant a sample of lead oxide powder, which Mr. Cary said had been given him by the Plaintiff with the request that he deliver it to the Defendant.

At this time, being the first time the Affiant ever met Mr. Cary, the Defendant Company was and had been successfully manufacturing lead oxide powder by the Hall process in a commercial way and in large amounts, and Defendant's interest in the Shimadzu sample was only general and such as Defendant would have in connection with any product useful, or said to be useful, in its business. In his efforts to interest the Defendant in the Shimadzu patents, one Mr. Ishimura, representing himself as an agent of Shimadzu, submitted Shimadzu's patents along with a proposed form of contract to the Defendant. The Defendant was advised by its counsel that the Shimadzu patents were not valid, and by its technical staff that the process and product of Shimadzu disclosed nothing of value over what was already known and in practice and in commercial use by the Defendant. For these reasons the Defendant dropped the negotiations. One of the reasons for the opinion expressed by counsel to the effect that the Shimadzu patents were invalid, was the early and successful work done by the Defendant, and it was in view of that early work that, under the advice of counsel, the Defendant instituted interference proceedings.

JOHN R. WILLIAMS.

Sworn to and subscribed before me this 18th day of December, A. D. 1933.

WM. C. DUBOIS,
(Seal) *Notary Public.*

STATE OF PENNSYLVANIA }
COUNTY OF PHILADELPHIA } ss:

Edward Wanton Smith, being duly sworn, according to law, deposes and says:

"I am a graduate in Chemical Engineering, of the University of Pennsylvania, and have practiced my profession for thirty-five years. I am the Manager of the Development and Design Division of the Defendant, and for many years was Factory Engineer for this Company.

From the beginning of the use of lead oxide powder by the Defendant, I have been intimately familiar with its production, with the machinery and equipment for producing it, and with the manufacture of plates made from it.

In the Summer of 1907, at the works of the Accumulatoren-Fabrik Aktiengesellschaft in Hagen, Germany, my attention was first directed to the manufacture of lead oxide powder for use in the manufacture of storage battery plates, in a rotating mill containing lumps of lead, and which was supplied with air, and from which the lead oxide powder was discharged through perforations in the wall of the mill. At that time such manufacture of lead oxide powder was not commercially known in the United States.

I arranged for the importation from Germany of, not only samples of the lead oxide powder, but also storage battery plates pasted with it. These were received in 1908 and 1909 in this country. They were tested and were so promising that in 1912 and 1913 I again visited the plant of the Accumulatoren Fabrik Aktiengesellschaft and obtained full details of the process and of the employment of the resulting lead oxide powder in storage battery plates.

The information acquired in Germany, corrobo-

rated by our own investigations was so satisfactory that in 1915 I put up for the Defendant in Philadelphia a mill which was completed in 1916 and operated, and a large number of plates were made from the resulting lead oxide powder.

These plates were so successful that twenty storage batteries containing them were sold to the New York Railways Company and put into operation. Their operation was so satisfactory that in 1918 a second lot of batteries, made from this lead oxide powder, and amounting with the first-mentioned batteries to 19,000 plates, was furnished to the same Company.

In 1920 Defendant engaged Clarence A. Hall, and he, under my supervision, introduced as an improvement on the German mill, a Hardinge mill of standard size. Under my supervision and general direction, with this and other like Hardinge mills since 1921, the Defendant has produced lead oxide powder to the extent of many million pounds. The lead oxide powder produced in the replica of the German mill and in the Hardinge mills was and is identical in all substantial and material respects, although with the Hardinge mill the powder was somewhat finer.

In or about May 1926 Mr. C. Reed Cary submitted to me a sample of lead oxide powder which he said was obtained from the Plaintiff and which was marked with Plaintiffs' name. From a careful examination of the sample of lead oxide powder submitted by Mr. Cary and from his meager description of the method of manufacture, and from a description of it given by Mr. Ishimura, I was then convinced that there was nothing new of value in the lead oxide powder and processes which Shimadzu was promoting.

In the course of his work in the making of lead

oxide powder in the Hardinge mills, Hall made some satisfactory experiments on its use as a paint. This was all prior to the year 1926 and the Defendant has never sold any paint of this kind or made it on a commercial scale.

EDWARD WANTON SMITH.

Sworn to and subscribed before me this 18 day of December 1933.

WM. C. DUBOIS.
(Seal) *Notary Public.*

STATE OF PENNSYLVANIA }
COUNTY OF PHILADELPHIA } *ss:*

Clarence A. Hall, being duly sworn according to law, deposes and says:

"I am a chemist and graduated in 1896 as such from the University of Pennsylvania. In July of 1920 I was employed by the Defendant to direct the design, installation and operation of a larger plant for the manufacture of lead oxide powder in continuation of the work previously done by the Defendant. I designed and installed a new plant and have directed its operation up to the present time.

Prior to my employment with the Defendant, I know that it had manufactured lead oxide powder in a replica of a German mill, and in continuation of that manufacture I introduced the use of Hardinge mills. With the Hardinge mill I had successfully produced large quantities, amounting to millions of pounds of lead oxide powder, before I ever heard of Shimadzu, and when I learned in April 1924 that Shimadzu had entered the field and (later) saw a sample of lead

oxide powder which I was told was his product, I was of the opinion that some of the product I had made corresponded with Shimadzu's sample. In this belief I instituted interference proceedings in the Patent Office to the end that no one else should enjoy patent rights for what I then considered to be my invention. It subsequently developed that in view of the prior art and of what had previously been done by the Defendant, the scope of my invention was somewhat curtailed. The fact is that prior to the time that I ever heard of Shimadzu or of any of his work and prior to the date of filing of any of Shimadzu's applications for the United States patents in suit, the Defendant was producing commercially and under my direction large quantities of the identical lead oxide powder which the defendant is today manufacturing, still under my direction.

Since 1921 to the present day the lead oxide powder manufactured by the Defendant and commercially used in the manufacture of storage battery plates has been continuously analyzed and carefully tested for its chemical and physical property and I have recently examined the records of those tests and analyses which are on file at the Defendant's office, and these records show, and I know it to be a fact, that the lead oxide powder manufactured by the Defendant and used in storage battery plates is the same now as it was in the beginning and has been the same throughout the entire period of manufacture. Furthermore the process has never been changed in the manufacture of lead oxide powder for use in storage battery plates from the beginning of 1921 to the present time and during all that time a Hardinge mill has been exclusively employed.

CLARENCE A. HALL.

Sworn to and subscribed before me this 18 day of December 1933.

WM. C. DUBOIS,
(Seal) *Notary Public.*

STATE OF PENNSYLVANIA }
COUNTY OF PHILADELPHIA } *ss:*

Joseph Lester Woodbridge, being duly sworn according to law, deposes and says, "I am a graduate in mechanical engineering of the Stevens Institute of Technology, and I am a doctor of engineering of the same institution. For many years last past I have been in the employ of the defendant as chief engineer and I have been frequently called upon to compare the subjects matter of patents and written descriptions, both in patent litigations in the courts and in the procuring of patent applications in the Patent Office and in the consideration of patents generally. I have made myself familiar with and I believe that I understand the various oxides of lead and also their manufacture and I am familiar with their use in storage battery plates.

I have read and I believe that I understand United States patents Nos. 1,584,479, 1,584,149 and 1,584,150 all granted to Shimadzu, and I know that Shimadzu is the plaintiff in this case. I have also read and I believe that I understand translations of Japanese patents Nos. 42,861, 42,728 and 42,563. These translations were, I am advised and believe, prepared under the direction of Langner, Parry, Card and Langner, International patent and trademark solicitors and agents of New York by Mr. Olpin a

doctor of science of Columbia University who has resided for a number of years in Japan and is familiar with the language of that country, with the assistance of a Japanese whose name I do not know and I believe that these translations are correct. I have also read, and I believe that I understand, British patent No. 197,031 to Shimadzu.

The subject matter described and referred to in the claims of letters patent No. 1,584,149 and 1,584,150 and in my opinion the process and product described in these two United States patents are identical, notwithstanding that in United States patent 1,584,149 the product is called reactive lead powder, and in United States patent 1,584,150 the product is called a powder of lead suboxide intermingled with powder of metallic lead. In both of these U. S. patents, the process comprises rumbling pieces of metallic lead in a revolving drum in the presence of air, whereby, by the abrasion of the lumps of lead a very fine reactive leaden powder is produced. In United States patent 1,584,150 a temperature between 60° and 200° C. is mentioned. In U. S. patent 1,584,149 no mention is made of temperature in the process, but in my opinion, as a result of the process described, the elevated temperature within the limits specified in U. S. patent 1,584,150 would unquestionably arise. The product described in both of these U. S. patents is identical as to its chemical reactivity and its physical characteristics. In U. S. patent 1,584,149 the claims are directed to a process of forming a finely divided chemically reactive lead powder. In U. S. patent 1,584,150 some of the claims are directed to a process for producing a mixture of lead and lead oxide without specifying any particular oxide; other claims are directed to a process and product in which lead sub-oxide is specified.

Japanese Patent No. 41,728 discloses the process consisting in placing pieces of metallic lead in a rotating vessel, rotating the vessel and grinding them to bits by means of the frictional rubbing of the lumps of lead on one another. The product is described as a highly reactive lead powder of very fine particles. Lead sub-oxide is not specifically mentioned in the patent. Reference is made to spontaneous combustion (oxidation) of the powder in the drum, which involves the presence of air in the drum and to elevated temperature sometimes making it necessary to dissipate the heat of friction.

Japanese Patent 42,563, is an improvement on Japanese Patent 41,728, in which a blast of air is introduced into the process for blowing the product out of the mill. Lead suboxide is not specifically referred to, although oxidation of the product in the mill is disclosed.

British Patent 197,031 to Shimadzu describes a product as a reactive lead powder and a process of producing a fine chemically reactive lead powder, consisting of tumbling pieces of lead in a rotating drum and supplying a blast of air inside the drum, whereby the lead balls are abraded and pulverized into a very fine powder, which is blown out of the cylinder by means of the air blast. On page 2, lines 25 to 32, reference is made to lead suboxide and in my opinion the meaning is, that the product becomes in part lead suboxide.

The application on which United States Patent 1,584,149 issued was made January 30, 1922 and the application on which 1,584,150 issued was made July 14, 1923, Japanese patent 41,728 issued February 13, 1922 on an application filed November 21, 1920 and Japanese patent 42,563 issued May 10, 1922 on an application filed November 27, 1920. Therefore the Japanese pat-

ents issued before the United States patents and the applications on which the United States patents issued were filed more than one year after filing of the applications on which the Japanese patents issued. British patent 197,031 was accepted May 7, 1923, and in the usual course was sealed shortly thereafter, and the application for it was filed February 2, 1922, and in my opinion the British patent was issued before both these U. S. patents were issued and on an application filed more than a year before the application on which American Patent No. 1,584,150 was issued. In my opinion British Patent 197,031 refers to the product in terms which clearly indicate that it was described as lead suboxide, although lead suboxide was not referred to in its claim. I am advised and believe that the omission to claim lead suboxide in the British patent had the effect to abandon that product to the public in the United States. In my opinion, the subject matter of the United States patents and that of the Japanese patents are in all substantial and material respects identical, although in the Japanese patents lead suboxide is not named. In my opinion the invention described in the British patent and in the United States patent 1,564,150 are substantially the same, including the specification of lead sub-oxide.

The United States letters patent No. 1584479, issued May 11, 1926 on application filed February 20, 1923, and Japanese patent No. 42,861, issued on June 17, 1922 on application filed August 3, 1921, hence the United States patent issued after the Japanese patent on an application filed more than one year later than the application on which the Japanese patent issued. Both of these patents describe the manufacture of storage battery plates from a paste made from the highly reactive lead oxide powder of apparent specific gravity less than 3.0, resulting from the abrasion of

lumps of metallic lead. While the Japanese patent does not specifically refer to sub-oxide of lead as the oxide used in making the plate, the British patent which issued before the United States patent on an application filed more than a year before the application for the United States patent, discloses as Shimadzu's invention the product lead sub-oxide, and by not claiming it abandons it in the United States to the public. In my opinion, and in view of the abandonment of lead sub-oxide to the public in the United States, the Japanese patent issued for substantially the same invention as the United States patent.

JOSEPH LESTER WOODBRIDGE.

Sworn to and subscribed before me this 18th day of December, 1933.

WM. C. DUBOIS,
(Seal) *Notary Public.*

STATE OF PENNSYLVANIA)
COUNTY OF PHILADELPHIA) *ss:*

C. Reed Cary, being duly affirmed, deposes and says:

I have never represented the Electric Storage Battery Company in any capacity whatever. In 1926, while in Japan on business for my company, I became acquainted with Mr. Shimadzu. Mr. Shimadzu told me that he was interested in the development of a process for the production of finely divided lead for storage batteries. He asked me if I was acquainted with any of the manufacturers of storage batteries in the

United States. I informed him that I was personally acquainted with one of the leading engineers of the Electric Storage Battery Company and he inquired whether I would be willing to show my friend some of their material and gave me a sample of the product. He then took me for a drive around the city, and stopped at a factory in which he was interested and which was engaged in manufacturing storage battery material. My visit lasted but a comparatively few minutes and he casually showed me a plant in which some machines were producing the powder in question. I had no particular interest in the matter and the above states all that I learned about the manufacturing process.

All that I saw was a chopper cutting lead bars into chunks, which went out of sight and when it reappeared was in the form of a fine powder. This represents the full extent of the knowledge I acquired concerning their processes.

After this visit I had no further occasion to meet Mr. Shimadzu, but on my return to this country a few months later I delivered the sample as requested and told Mr. E. W. Smith that my Japanese friends wished them to look into the merits of their process and product, and delivered to him the sample, after which I considered my mission completely fulfilled.

(sgd.) C. Reed Cary.

Affirmed and subscribed before me this 14th day of December, 1933.

(Illegible)
(Seal) *Notary Public.*

STATE OF PENNSYLVANIA }
COUNTY OF PHILADELPHIA } ss:

Edward W. Smith, being duly sworn according to law deposes and says that the Defendant has never practiced the process described in patent No. 1,584,-151, and has never oxidized lead suboxide to litharge or other higher oxide which is the product of that process.

Sworn to and subscribed to before me this 19th day of December, 1933.

EDWARD W. SMITH.

My Commission expires April 4, 1935.

EVERETT S. RODEBAUGH,
Notary Public.

DEFENDANT'S MEMORANDUM IN OPPOSITION TO PLAINTIFFS' MOTION TO INSPECT DEFENDANT'S PLANT.

At the argument defendant offered to submit authorities dealing with plaintiffs' right to inspect defendant's plant under the facts set up in defendant's answer to plaintiffs' motion.

Substantially all the cases found upon this matter follow:

Walker on Patents, Sec. 672, says:

> "Mere suspicion of infringement is not sufficient to justify the issuance of an order for inspection."

In the case of Dobson v. Graham, 49 Fed. 17 (Pa.)

plaintiff moved for inspection of defendant's machinery. Judge Butler dismissed the motion saying:

> "* * * the plaintiff filed his bill charging infringement of his rights without having any positive knowledge upon the subject. He seems to have relied upon the chance of obtaining evidence to support the charge from the defendant and his workmen. Such a case is not entitled to the special favor of a court of equity. The defendant's business is conducted in private, for the purpose of securing to himself (as he asserts) the use of his peculiar machinery and methods of manufacture. These secrets of his business, if they cover nothing unlawful, are his property and as well entitled to protection as the rights secured by the plaintiff's patent. His workmen are bound by express contract not to divulge them. In the absence of such contract equity would imply an obligation of equal force. If it were shown that these secrets are used as a cloak to cover an invasion of the plaintiff's rights, or if there was reliable evidence tending to show it, and justifying a belief that they are sound, the motions would be sustained. But there is no such evidence before us. It appears that the defendant employs certain workmen who were formerly employed by the plaintiff; that these workmen are familiar with the plaintiff's patented machinery, and that they aided in constructing the defendants. This is substantially all. These workmen have been permitted to answer questions directed towards a comparison of the defendant's machinery with the plaintiff's except where the answer would tend to describe wherein the former differed from the latter, and thus to describe the peculiarities of the defendant's machinery. The court cannot properly compel them to go further, nor, in this state of facts, compel the defendant to submit his machinery to inspection."

Eibel Process Co. v. Remington-Martin Co., 197

Fed. 760, is a suit on motion for inspection of defendant's alleged infringing machines and to compel defendant to furnish samples of its product. Judge Ray denied the motion, saying:

> "I am not called upon to express any opinion as to the defense of prior use, etc., the antiquity of the idea expressed in the patent. The defendant has not had opportunity to cross-examine the persons whose affidavits are presented on this motion, and, if their testimony is taken, it may not cross-examine or controvert anything they testify to. By testimony taken in the case the complainant has not made a prima facie case of infringement. It does not as yet appear that there will be any dispute or controversy as to the elevation of the breast-roll end of defendant's screens, or their length.
>
> "The composition used by defendant in making its paper is no concern of the complainant at this stage of the case, and so far as appears, defendant's product is on the market. I think the motion premature. It is a serious thing to direct a manufacturing corporation to allow the attorney and agents and experts of a rival concern to enter its plant and inspect and measure its machinery and the operation thereof and compel it to furnish samples of its stock and product. 'Suspicion' of infringement is not enough to justify such an order as is asked for, and I decline to follow Rowell v. William Koehl Co. (D. C.) 194 Fed. 446, 447, where it is indicated that 'suspicion of infringement' will justify an order of inspection. A prima facie case made by taking testimony and concealment by defendant of its alleged infringing devices, or of plans, drawings, and documents would justify such inspection. This is the doctrine of Dobson v. Graham (C. C.) 49 Fed. 17, and Diamond Match Co. v. Oshkosh Match Works et al (C. C.) 63 Fed. 984, 985. In Diamond Match Co. v. Oshkosh, etc., supra, the court said:

> 'The complainant is not entitled to the aid of the court, upon the suspicion or an allegation of infringement, to pry into the business operations or appliances of the defendants, either to the end of making out a case against them, or for any other object. The defendants are entitled to protection in their rights and property, and will not be required to make premature disclosures of their matters of defense.'

"And in Dobson v. Graham, supra, the court said:

> 'Complainant will not be granted an inspection of machinery of defendant kept in secret, and claimed to embody important secrets, when complainant produces no evidence tending to show that it infringes his patents.'
>
> "* * * I do not think such an order as is asked for here should be granted an affidavit made prior to the taking of testimony in the case, except possibly in exceptional cases of which this is not one. As at present advised, I see no reason whatever for ordering the production or examination of defendant's stock or product.
>
> "The motion is denied * * *."

The case of *Stokes Bros. Mfg. Co. v. Heller*, 56 Fed. 298 (N. J.) was heard on complainant's motion for an order that defendants permit an inspection of their factory. Judge Green denied the motion saying:

> "They (the complainants) now move the court to order that the defendants do permit a ful and thorough inspection of their manufactory, situate in Newark, N. J., and all of their machinery, and of all their processes for the manufacture of the rasps or files made by them, and which files and rasps, and processes and machines, the complainants allege, infringe their letters patent. The defendants, in their answer, deny infringement, and furthermore assert, under oath, that rasps have been manufactured by them, by a peculiar

process, not patented, but kept as a secret in their business, since 1836; and they produce files and rasps before the court, which, as shown by affidavits uncontradicted, were made many years before the letters patent in question were issued, and which to the eye, at least, seem to be entirely similar to those now made by the complainants. Under these circumstances, to compel the defendants to open their manufactory to hostile inspection of rivals in business, and to disclose the character of the machines and the process by which for so many years they have made a successful article of merchandise, would be unjust and inequitable. The motion is too obviously the excuse for a 'fishing excursion', and does not, under the circumstances of this case, commend itself to the court."

In *Germ Milling Co. Ltd. v. Robinson*, 1 T. L. R. 38, 1 R. P. C. 217 (1884) the plaintiffs were the proprietors of the patent of a machine for "improvement in the manufacture of meal and flour from wheat etc.", which they alleged had been infringed by the defendant. The plaintiffs now sought to obtain inspection of the defendant's machinery, which was resisted, upon the grounds: (1) That the plaintiff's specification was too vague; and (2) that no sufficient particulars had been given by the plaintiffs of the acts of the defendants which were alleged to constitute a breach of plaintiffs' patent. Held that all the plaintiffs showed was that they suspected an infringement on the part of the defendant, and that, inasmuch as the particulars of breaches were described in too general words, it was not a case in which the court would order inspection. The request to inspect was by motion. The court, speaking through Mr. Justice Kay, on page 219 said:

"The reason for which I think it is not proper

to grant an inspection at this moment is this, that the patent, as stated shortly, seems to me to be a patent for a rather elaborate process of manufacturing meal and flour * * * I do not wish to give the least opinion upon the matter one way or the other now, but it may be that every single process of that may be old, and yet the whole process, by being combined in a new way to that in which it has ever been used before, or for other reasons, may be a perfectly good subject of a patent. On that I do not mean to give an opinion one way or the other, but the plaintiff in this case has stated that the defendants have infringed, and the only particular of breaches he gives is this: 'Since the date of the assignment the defendants have manufactured, and they continue to manufacture, meal and flour from wheat and other grain by a process identical with, or substantially similar to, that described in the specification'. Of course this is not a particular at all. It is as general a statement as you could put into words; and to call that a particular of breaches seemed to me to be a contradiction in terms. Then in the affidavits, no doubt, as Mr. Ashton has pointed out, the plaintiff does say something a little more definite. He says in the fifth paragraph, 'The defendants are extensive corn millers at Greenwich, and they have recently introduced therein machinery for reducing wheat into flour by means of rolling and sifting, and I verily believe that the defendants are now manufacturing wheat into flour by means of my said invention, and by the process or means described in my said specification, or only colourably differing therefrom'. The first thing I have to consider is, what sort of evidence is that? There is a rule in this Court, that where a person states, as he may in an affidavit upon an interlocutory motion, his belief, of a fact, he must state the grounds of that belief. What are the grounds for that belief? There are absolutely none; I mean there are none stated. That means, this, then: 'I suspect', (be-

cause 'I believe' without any grounds is only 'I suspect') 'that the defendants are manufacturing according to my process.'' Thereupon, without any particular, without any evidence which the court ought to look at as being evidence of infringement, I mean even the most *prima facie* evidence of infringement, the plaintiff comes to the court and says, 'Grant me inspection'. The defendant's answer in effect, because I am not giving the words, is, 'I have a great many processes in my mill which are trade secrets, which I do not want people to inspect'. That is a very good answer unless the plaintiff makes out a strong ground for inspection, but in point of fact the whole of this pleading and evidence before me now amounts only to this: for some reason, which is not expressed, I, the plaintiff, say, 'I suspect the defendants are infringing this elaborate process of mine,' if he had said, 'The nature of the flour they produce is such that it could not have been done by any other process', and satisfied the court to that, that would be one thing * * *. But he says nothing of the kind, and this is really no more than this, taking the pleadings and affidavits, and every thing which are before me, 'I suspect and I will not tell you my grounds for suspecting, that the defendant is infringing this elaborate process of mine, and I ask for leave to go and look into his works to see whether I can make a case against him or not'. That is not the way in which the Court can grant inspection, and therefore at present I decline to make any order on the motion."

In *Chbetham v. Oldham & Fogg*, 5 R. P. C. 617 (1888), the plaintiff, as patentee of an invention for "improvements in the manufacture of felt hats, caps and other head coverings, and in the apparatus employed in such manufacture" commenced an action against defendants for infringement, and moved for

an inspection of defendant's processes, apparatus and machinery. The Court held (b) that a prima facie case of infringement will support a claim for inspection by a plaintiff (c) that inspection must be limited to those of the defendant's processes as to which a prima facie case of infringement has been made out, and as the plaintiff's evidence as to all the defendant's processes, except one, amounted only to suspicion on his part that they constituted infringements without the ground of such suspicion being stated, inspection must be limited to such one process. The inspection was asked for in this case by motion. Bristow, V. C. says at page 620:

> "* * *; but I think inspection in matters of this kind must be kept within some limit, and that a roving inspection cannot be a right thing to order, except upon reasonably clear evidence that the inspection sought, whether of a process or a mode of manufacture, or the uses of machinery as the case may be, is really required for testing the alleged infringement."

Again at page 621:

> "Now, then, I have to think what is the inspection to which they are entitled. In my judgment it must come to this:—there must be an inspection of all that is sufficiently proved at the present moment to be a prima facie case of infringement, absolute infringement not, but a prima facie case of infringement. But to carry it beyond that I do not think I ought to make an order for inspection. * * * I think, following the view taken by Mr. Justice Kay in the case of the Germ Milling Co., 1 R. P. C. 217, I ought not to grant inspection generally over the defendant's premises, the final statement in evidence being merely that 'it may probably be' that the defendants adopt other processes which are infringements."

McDougall v. Partington, 7 R. C. 351 (1890) was an action to enforce the performance of a contract, providing that the parties were to share all information and discoveries, the parties were to be allowed to inspect each others works. Any patents obtained during the period were to be vested in plaintiffs and the defendant was entitled to work them under a license at a royalty. Plaintiffs claim specific performance claiming that defendant had made and was using certain improvements of which he had not given them information; that he (defendant) would allow them to inspect his works etc. The defendant attacked the contract on fraud, misrepresentation, abandonment and other grounds. He also denied that he was using any process that came within the terms of the contract. The plaintiffs applied for inspection of the defendant's works. This was resisted on the grounds that, for the purpose of preparing for the trial of the action, no such inspection was necessary. Held, that inspection must be refused. Vice-Chancellor Bristowe said at page 356:

> "* * * It is obvious that that is a very large demand on the part of the plaintiffs—that they may be at liberty by themselves, their counsel and solicitors in the usual way to enter into the whole business premises and works of the defendants, 'and examine the whole of the processes there used and practiced in the formation of wood or paper pulp' in the manner referred to—to make experiments, to take samples, and to require the processes to be worked for their purposes. In the outset, I think it is right to state that in my view of the authorities on the subject, apart from this particular case, the right in a case of this kind to inspection is not so high as it has been put. I do not think (and having regard to the authorities, I think that the proposition I am about to lay down is a true one) that there is an absolute right on the part of a person, suing as the plaintiff sues

here, to inspection without anything more than merely saying, 'I desire inspection, and therefore I will have it'. I think it is not such a matter of right."

The Vice-Chancellor then reviews all the early decisions and says (page 356):

"You cannot, in my judgment, read those judgments without coming to the conclusion that the Court of Exchequer held at that time that it was not a matter of right. Those cases remain pretty much as they were."

Continuing on page 357:

"It is not a case of absolute right, but it is a case of showing that the Court ought, in the exercise of its discretion, to make the order for inspection. I think also that you cannot look at the decisions of V. C. Bacon in Batley v. Kynoch without coming to the same conclusion, namely, that there must be no inspection, unless it was absolutely essential to the plaintiff's case * * * It seems to me that it is carefully guarded, that the right of inspection is a right to be given at the discretion of the court—to be exercised with a judicial discretion and with due regard to the interests of the parties concerned in the litigation."

In conclusion at page 360, the Court said:

"Bearing in mind the great difficulty and the serious loss and injury which might be caused to the defendant by an inspection; and the, to my mind, comparatively little use, if any use at all, to the plaintiff, I come to the conclusion that there is no case here, in which the Court, exercising, as I think it is bound to exercise, judicial discretion, ought to make any further order for inspection. Refused."

In *Batley v. Kynoch*, 44 Law Journal Reports

(Chancery) 89 (1875), plaintiffs in a suit for the infringement of a patent held by them for the manufacture of certain cartridges applied by motion for an inspection of the machinery and premises of the defendants, who were also large cartridge manufacturers. Defendants alleged by affidavits that the inspection was only asked for to enable plaintiffs to see their machinery, and they believed it to be unnecessary for purposes of the suit:—Held that as there was no allegation by the plaintiffs that such inspection was necessary, and as there was an allegation by the defendants that it was not necessary, the motion must be refused. Bacon, V. C. at page 90 said:

> "There can be no doubt that in such a suit as the present the plaintiff has a right to any evidence which may be necessary to enable him to prove the infringement which he alleges. In this case, however, the plaintiff has made no allegation by affidavit or otherwise that the inspection he asks for is necessary for the purposes of the suit, and the defendants, on the contrary, have made a distinct allegation that the inspection is unnecessary. * * * The motion for inspection must therefore be refused."

PLAINTIFFS HAVE SHOWN NO PRIMA FACIE CASE OF INFRINGEMENT.

Defendant has shown on page 4 of its answer to plaintiffs' motion for inspection that:

> "The product made by the Defendant in 1921, is the same as the product made by it at the present time, and the process and apparatus employed are identical."

In *Hall vs. Shimadzu*, 59 Fed. (2d) 225, 226, the Court of Customs and Patent Appeals said:

> "While the preliminary statement of appellee

alleged conception and reduction to practice prior to his filing date of July 15, 1923, both the Examiner of Interferences and the Board of Appeals held him to said filing date for both conception and reduction to practice. In view of the conclusions we have reached, it is unnecessary to examine the action of the Patent Office tribunals on this point."

It follows that since defendant's product and process are the same now as in 1921 they cannot now infringe plaintiffs' claims for the prior use in 1921 would invalidate those claims, if the product and process fall within them.

In the Patent Office defendant contended that its product and process were the product and process of the counts in interference. This the Patent Office tribunals and the Court of Customs and Patent Appeals denied, and were urged so to do by the plaintiff, Shimadzu.

There is no scintilla of evidence that the product and process of defendant here are not the same as they have been since 1921.

MOREOVER, DEFENDANT HAS HERE DISCLOSED WHAT ITS PROCESS AND PRODUCT ARE.

On page 4 of its answer to plaintiffs' motion defendant has said:

> "The mill so employed in 1921 is illustrated and described in patent No. 1,675,345, and the process and product are described in patent No. 1,888,823, both to C. A. Hall."

The information contained in these two Hall patents is necessarily sufficiently full and clear not only to enable anyone to understand the machine, process and

product but also to practice the process, make and use the machine, and produce the product. Section 4888 of the R. S. provides that before an inventor shall receive a patent for his invention or discovery he "shall file in the Patent Office a written description of the same, and of the manner and process of making, constructing, compounding and using it, IN SUCH FULL, CLEAR, CONCISE AND EXACT TERMS AS TO ENABLE ANY PERSON SKILLED IN THE ART OR SCIENCE TO WHICH IT APPERTAINS, OR WITH WHICH IT IS MOST NEARLY CONNECTED, TO MAKE, CONSTRUCT, COMPOUND, AND USE THE SAME; AND IN THE CASE OF A MACHINE, HE SHALL EXPLAIN THE PRINCIPLE THEREOF, AND THE BEST MODE IN WHICH HE HAS CONTEMPLATED APPLYING THAT PRINCIPLE * * *." The presumption is that the Patent Office required Hall to comply with the provisions of the Statute. It appears that Plaintiff is already in possession of a full, clear, concise description in exact terms such as enables any person not only to understand what defendant is doing but also to practice the inventions that defendant is using. With such information in hand plaintiff, if acting in good faith, ought to know whether or not, in plaintiff's opinion, defendant is infringing.

At the argument the plaintiff in connection with its patent 1,584,150, sought to carry its effective date back of its filing date, July 14, 1923, by reference to the first paragraph in the description. Plaintiff unsuccessfully made that same contention in the suit in substance between the same parties as the present suit, which was decided by the United States Court of Customs and Patent Appeals. In 59 Fed. Rep. (2nd), page 226, the Court of Customs and Patent Appeals said, "While the preliminary statement of appellee

(Shimadzu) alleged conception and reduction to practice prior to his filing date of July 14, 1923, both the Examiner of Interferences and the Board of Appeals held him to said filing date for both conception and reduction to practice." The Court of Appeals stated that in view of its conclusions it was unnecessary for it to examine the action of the Patent Office tribunals on this point. On page 215 of the Transcript of Record in the decision of the Board of Appeals the following appears:

> "Shimadzu is involved upon his patent, 1,584,150, of May 11, 1926, filed July 14, 1923, and it appears from the Record that he is confined to that date."

CONCLUSION.

It follows that plaintiffs have not only failed to make out a prima facie case of infringement but that unless the conclusion of the Patent Office tribunals made at the insistence of Shimadzu is to be overruled on this motion at the instance of Shimadzu, it is obvious that defendant is not infringing any valid claim of Shimadzu's patent.

Moreover, it appears that plaintiffs have under the Hall patent above referred to, all the information to which they would be entitled had they made out a prima facie case of infringement.

Plaintiffs' motion should be denied.

Respectfully submitted,
HUGH M. MORRIS,
AUGUSTUS B. STOUGHTON,
A. F. KWIS,
E. S. W. FARNUM, JR.

DEFENDANT'S SUPPLEMENTAL MEMORANDUM IN REPLY TO PLAINTIFFS' MEMORANDUM AND SUPPLEMENTAL MEMORANDUM IN SUPPORT OF PLAINTIFFS' MOTION FOR INSPECTION.

PROCEEDINGS IN THE PATENT OFFICE.

The parties to this infringement suit are the same as the parties to the interference Hall vs. Shimadzu decided by the Court of Customs and Patent Appeals, 59 Fed. (2nd) 225.

In the interference proceeding the subject matter involved was limited to lead suboxide as claimed in Plaintiffs' Patent No. 1,584,150, here in suit and more particularly referred to by Plaintiff.

From Plaintiffs' Supplemental Memorandum, page 14, and elsewhere, it appears that Plaintiff is seeking inspection of an unusually searching character and of the widest latitude in respect to lead suboxide.

The Court of Customs and Patent Appeals held 59 Fed. (2nd) 227, "that the phrase here under consideration (a process of manufacturing a fine powder of lead suboxide intermingled with powder of lead appearing in the claims or counts) is more than merely an introductory phrase, and is absolutely essential to point out the invention that is here involved."

Hall introduced evidence showing all the facts of his invention and excerpts from it are given in Plaintiff's Supplemental Brief. These excerpts indicate that Hall and his witnesses believed and stated and were of opinion that the powder which they made from the beginning contained suboxide of lead. Shimadzu introduced evidence of which the following sample was

given by S. Ishimura who had been engaged in business with Shimadzu from 1906 to 1908, and from 1917 to date.

We quote from page 129 of the record in the interference case:

> "Q. 31. Was the apparatus that you used identically the same as that shown in Hall patent application, and was the process carried out identically the same as the specification requires?
>
> A. I think so, because we used a Hardinge type of six feet standard mill.
>
> Q. 32. Mr. Ishimura, were you able to get any suboxide of lead in your experiments with what you say was a duplication of the Hall apparatus and a duplication of the Hall process as described in his specification—could you get any suboxide of lead?
>
> A. I do not think I can get any suboxide."

The same witness at page 475, says:

> Q. 36. Mr. Ishimura, what was the color of the product that you obtained in the Depew test from the Hardinge mill?
>
> A. Yellowish sort of gray.
>
> Q. 37. What is the color of the powder that you get by following the Shimadzu process?
>
> A. Black. That is, if you describe the substance of lead suboxide, that is a definite chemical compound having certain chemical properties, and also physical properties, that include and specify definitely the color of the product, which is supposed to be black.

At page 525, Shimadzu's witness, Harold M. Wood, an expert chemist, says:

> Q. 45. In your experience in the manufacture of this powder, what would be the characteristics of the powder obtained from the Shimadzu ma-

chine as compared with the powder obtained from the Hardinge machine?

A. A powder obtained from the Shimadzu machine contains a major portion of lead suboxide, *whereas the powder obtained from the Hall machine contains no lead suboxide.* The powder from the Shimadzu machine is black in color, whereas the powder from the Hall machine is olive-gray in color. The powder from the Shimadzu machine when touched with a match, will oxidize rapidly in the atmosphere, the reaction spreading throughout the mass of the powder. This is not true of the powder obtained from the Hall machine. (Emphasis supplied.)

The testimony quoted by plaintiff's attorney from the interference case, if it be construed to apply to defendant's lead oxide powder produced after the date of Shimadzu's patent, merely confirms defendant's assertion that his product has been the same both before and after that date.

While briefs of counsel are not parts of the record some light may be shed on Plaintiff's position in the interference proceedings by referring to extracts from the briefs filed by Plaintiff in the Patent Office proceedings.

In the brief for Shimadzu before the U. S. Court of Customs and Patent Appeals, pages 12 and 13, the following statement appears:

"What gives life to all the counts in both these interferences is the inclusion therein of the 'suboxide of lead' in interference 54,798 and the more specific counts specifying the proportions of suboxide and pure lead in 56,224. That is all that renders the counts patentable over the Bailey patents 846,384 and 846,444 discussed in the Interference Examiner's decision in interference 54,798 and in Mr. Hall's deposition pp. 64 to 67. (Rec. p. 320) in interference 56,224. Hall's right to in-

clude this lead suboxide powder in his claims was the storm center of interference 54,798. That identical point was the crux of interference 56,224."

Since the only novelty in Shimadzu's claims is the production of lead sub-oxide it is necessary for him in order to establish a prima facie case to show that defendant is making lead sub-oxide. Since the above quotation is an admission that there is no novelty in the steps of the process or the details of the apparatus disclosed and claimed by Shimadzu, there is no basis for giving him access to defendant's plant in order to obtain information in regard to these features.

In regard to the product, Shimadzu in the interference case successfully contended that plaintiff's product was not, and is not, lead sub-oxide and that defendant cannot make lead sub-oxide in his apparatus. This statement is supported by the following quotations from briefs for Shimadzu in the interference case.

In the brief for Shimadzu before the United States Court of Customs and Patent Appeals, page 16, the following statement is made:

"The color of suboxide of lead mixed with a small proportion of lead powder, as shown by Shimadzu's samples, is black. The color of Hall's powder as set forth in his application for patent, 'olive gray,' would as accurately as any other words describe the color of a mixture of litharge and pure lead powder."

Near the bottom of page 26 of the same brief the following statement appears:

"Mr. Hall and all his witnesses repeatedly admitted that his product shows olive gray in color as specified in his specification."

In the brief for Shimadzu before the Board of Appeals in the interference case on page 67, paragraph 5, the following statement is made:

> "5. That even if it be assumed that the apparatus of Hall's application could produce lead suboxide in appreciable amounts, *and it cannot*, there is no disclosure in Hall's testimony as to what form of apparatus or what process he finally considered was a satisfactory reduction to practice prior to the filing of the Hall application."

Shimadzu's testimony was corroborated and was accepted by the Court of Customs and Patent Appeals instead of Hall's testimony.

On this testimony for Shimadzu the Court found that Hall never disclosed suboxide of lead and, therefore, could not claim a powder in which it predominated. Therefore, the Court held that Shimadzu, who did disclose suboxide of lead, was the first inventor of it and entitled to patent claims for it.

The Court also found, top of page 226, second column, 59 Fed. (2nd) that Shimadzu was limited to July 14, 1923, for both conception and reduction to practice of the lead suboxide invention.

As pointed out in Defendant's Answer to the Motion for Inspection, page 5, Par. a, Hall was given the early part of 1921 as the date of the invention described and claimed in his application and which the Court held did not involve suboxide of lead. The Hall application referred to is now patent 1,888,823, under and in accordance with which the Defendant is operating.

Since the early part of 1921, Hall's date of invention, is more than two years prior to July 14, 1923, Shimadzu's date of invention, it appears that if Hall's process, product and apparatus infringe Shimadzu's patent they must also anticipate Shimadzu's patent

and thus negative any idea of prima facie proof of infringement such as is necessary to support a motion for inspection. In fact, these dates raise a presumption of no infringement. Plaintiff is between the horns of this dilemma as was stated at the oral argument of this case.

To extricate itself from this position Plaintiff in its Supplemental Brief, pages 3 and 12, refers to the following statement in Shimadzu's patent 1,584,150:

> "This application is a continuation in part of application No. 431,473, filed Dec. 17, 1920."

Patent 1,584,150 is the suboxide patent and it was involved in the Shimadzu-Hall interference where the same contention was unsuccessfully made because the Court of Customs and Patent Appeals notwithstanding that statement in the patent gave Shimadzu July 14, 1923, as the date of his invention.

THE APPLICATION FOR PATENT 1,584,150 IS NOT A CONTINUATION OF APPLICATION 431,473 IN RESPECT TO LEAD SUBOXIDE.

It is obvious that the application for patent No. 1,584,150, filed July 14, 1923, could be a continuation of the earlier application No. 431,473, filed Dec. 17, 1920, only to the extent that the earlier application contained the same subject matter or part of the same subject matter as the later application. We file herewith a certified copy of application 431,473. From that copy it appears that the application 431,473, as filed in 1920, said nothing about rubbing together lumps of lead in a tumbling mill and producing lead powders, as stated at the bottom of page 2, and the top of page 3, of Plaintiff's Supplemental Memorandum on Motion for Inspection, or about a mill nor about pro-

ducing lead suboxide other than to state: "It is also necessary that fresh lead powder is employed, as suboxidized lead is less active than pure lead." On July 18, 1922, an amendment was presented and in it reference was made to a mill but not to lead suboxide. The Patent Office held that this amendment covered new matter and refused to enter it and held that the disclosure was insufficient. Another amendment was presented May 2, 1924, and in reply on May 20, 1924, the Patent Office repeated its objection and the application became forfeited and dead.

At no time was there in application 431,473, any description of a mixture of suboxide of lead and metallic lead, or of any method of making the same.

At the oral argument of this case, as reported stenographically, and on page 73, Mr. Newton, of counsel for Plaintiff, stated: "that there was as good a disclosure in the Shimadzu case of 1920, as there was in the Hall case." The 1920 case of Shimadzu is application Ser. No. 431,473, and the Court of Customs and Patent Appeals held that in Hall's case there was no disclosure of the suboxide powder. From Mr. Newton's statement it follows that in Shimadzu's 1920 case there was no disclosure of suboxide of lead; consequently it follows that the suboxide of lead invention of the patent in suit cannot be carried back to the date of the 1920 application.

MORGAN vs. DANIELS.

Plaintiff in its original Memorandum refers to Morgan vs. Daniels, 153 U. S. 121. The head note in that case is as follows:

> "When a question between contending parties, as to priority of invention, is decided in the Patent Office, the decision then made must be accepted as controlling, upon that question of fact in any sub-

sequent suit between the same parties, unless the contrary is established by testimony which, in character and amount carries thorough conviction."

In the present case the parties are the same as the parties to the litigation in the Patent Office, and on the question of priority of invention the Patent Office decided that as to the lead suboxide invention Shimadzu was first and entitled to a patent, and that as to Hall, Hall's powder was ahead of Shimadzu, or otherwise stated, the Patent Office decided that Shimadzu had a right to a patent for the lead suboxide proposition, and that Hall had a right to a patent for his process, product and machine. Applying the doctrine of Morgan vs. Daniels it seems that the Patent Office decision must be accepted as controlling. If the Patent Office decision means anything it means that Hall was first in point of time and that Hall was not entitled to make claims for Shimadzu's lead suboxide proposition because Hall never disclosed it at any time. Another way to put it is to say that the Patent Office decided that each of the parties was entitled to a patent for his invention and that Hall made his invention first. The application of Morgan vs. Daniels seems to negative the proposition that Hall and the Defendant are infringing Plaintiff's Shimadzu Patent.

In addition to the above it appears from Paragraph 3 of Defendant's Answer to the Motion for Inspection that Defendant has been using and or making the same product which it is now making, beginning in 1908.

QUESTION OF INSPECTION.

In considering the question of inspection, the equities may well be balanced. On Defendant's side

is the result of twenty-six years of experience concerning the exact temperatures employed and the details of operation, mechanical arrangement and the like. On Plaintiff's side is the comparatively newcomer of only ten years' standing, with a lead suboxide proposition which the Court of Customs and Patent Appeals has said was never disclosed by Hall and which the Patent Office said was later even than Hall.

—ooo—

Plaintiff rejects or at any rate does not ask for a sample of Defendant's product, and at page 14 of its Supplemental Memorandum gives the following ground for its action. Contrary to its testimony in the interference, and to the decision in the interference proceedings and contrary to the decision of the Court of Customs and Patent Appeals to the effect that lead suboxide cannot be made in a Hardinge mill by Hall's process, Plaintiff now wants this Court to assume that Defendant is making a lead suboxide powder in a Hardinge mill and upon that assumption asks this Court to order an inspection and disclosure extending way beyond the claims of the lead suboxide patent in suit.

Of the six patents in suit, the pivotal patent is 1,584,150. In this patent claims 1 to 13, inclusive, are process claims, while claims 14 to 17 are product claims. To determine infringement of the product claims, inspection of Defendant's plant is not essential.

The process set forth in the claims of this patent includes the following steps, viz.:

(a) Putting pieces of metallic lead into a rotatable vessel in a dry state,

(b) Introducing a current of air or other oxidizing gas into the vessel.

(c) Rotating the vessel, thereby abrading off the oxide formed on the surface of the lead.

(d) Maintaining the temperature of the material between 60° C. and 200° C.

Defendant admits that it is employing these steps in its process, as disclosed in the Hall patent 1,888,823, and has been using them since 1916.

Claim 2 calls for blowing the powder out of the mill.

Defendant admits that a small portion of his product is carried out of the mill in the dust laden air, as disclosed in the Hall patent but the greater proportion is discharged in accordance with the well-known principle of the Hardinge mill without depending upon the air blast.

Claim 5 calls for a heat insulating means.

Defendant uses no heat insulating means, but on the contrary employs cooling means, as disclosed in the Hall patent.

Claim 7 includes steel balls with the pieces of lead.

Defendant does not use steel balls.

The facts in respect to those elements in plaintiff's process claims which defendant denies using may all be determined by interrogatories, without inspection of the plant.

Plaintiff has no right to gain by inspection of defendant's plant, knowledge of those features of Defendant's process or those details of Defendant's apparatus which are outside of the scope of the claims of the patents in suit. For example, he has no right to know the size or shape of the pieces of lead fed into

Defendant's mill, nor the rate of such feed, nor the device or devices by which such feed is effected. Knowledge as to whether Defendant does or does not put pieces of lead into a rotating vessel is all that he is entitled to, and such knowledge is available without inspection. Plaintiff is not entitled to know the exact temperature maintained in Defendant's mill nor the means by which the temperature is controlled. Knowledge as to whether or not such temperature is held within the limits of 60° C. to 200° C. is all that Plaintiff is entitled to, and it has been admitted and is now admitted that it uses a temperature within those limits.

Plaintiff is not entitled to know the quantity of air supplied to Defendant's mill, nor the means for controlling it. Knowledge that air is supplied to the mill is all that Plaintiff is entitled to, and it has been admitted and is now admitted that air is supplied to the mill.

The process of the two claims of Shimadzu's patent 1,584,149, includes no other steps than those already referred to and does not therefore entitle Plaintiff to inspection of Defendant's plant.

The claims of Shimadzu's patent 1,584,151, cover a process for further oxidation of the product covered by patent 1,584,150. Defendant has submitted affidavits absolutely denying the use of any such process. No inspection is required in respect to these claims.

The claims of Shimadzu's patent No. 1,584,152, cover the use of lead oxide powder resulting from the process of patent No. 1,584,150, in the manufacture of paint. Defendant has submitted an affidavit denying the use of his lead oxide powder in the manufacture of paint. No inspection of Defendant's plant is required in respect to these claims.

The claims of Shimadzu's patent No. 1,584,479

cover the use of a lead suboxide powder in the manufacture of storage battery plates. Defendant admits that it uses its lead oxide powder in the manufacture of storage battery plates. No inspection of Defendant's plant is necessary.

Shimadzu's patent No. 1,896,020, was issued on an application filed April 27, 1926. It discloses his apparatus for the manufacture of lead oxides, and its claims are directed to specific features of such apparatus not used by Defendant. Defendant has filed affidavits stating that the apparatus it uses is the same as it used more than two years before the filing date of Shimadzu's patent. If further information is required in regard to Defendant's use of specific features covered by the claims of the Shimadzu patent No. 1,896,020, such as the use of a screw conveyor for feeding the pieces of lead into the drum, or the use of jets for delivering compressed air into the interior of the drum, or the use of an injector in the outlet of the drum, or the supplemental means for the further oxidation of the powder into litharge, none of which features is employed by the Defendant, such information can be obtained by interrogatories, without inspection of Defendant's plant.

Résumé.

Perhaps in repetition of what has been stated in Defendant's Answer to the Motion we may add the following résumé.

An order of inspection is not to be granted as of course, and protection will be given against impertinent intrusion; suspicion of infringement is not enough to justify an inspection, and a prima facie case or showing must be made. In the present case Plaintiff has failed to make a prima facie case or showing of infringement but, on the contrary, has made a prima fa-

cie case or showing of either non-infringement or of invalidity by anticipation.

In the Patent Office proceedings Hall, in whose shoes Defendant stands, introduced testimony (set out in Plaintiff's Supplemental Memorandum to the effect that Hall made lead suboxide powder in a Hardinge mill by his process, and Plaintiff introduced testimony (set out in this Memorandum) to the effect that lead suboxide could not be made in a Hardinge mill by Hall's process. The Plaintiff prevailed and has a patent for lead suboxide, and Hall has a patent for his process, product and machine, which was given the date of the early part of 1921, whereas Shimadzu was given the date of July 1923; and it has been shown that the application No. 431,473, of 1920, totally lacks any disclosure upon which the date of Shimadzu's suboxide invention can be carried back. Defendant swears that it is using, and always has used, the Hall process in a Hardinge mill, and Plaintiff gives no evidence of any change in the process but merely suspects infringement which is not enough to warrant inspection. At the oral argument Mr. Whitcomb, page 64, in answer to a question by the Court, stated that Plaintiff's case depends entirely on Hall's testimony. At page 64, the Court stated Defendant's contention, saying in substance, if Hall is wrong then there is not even a prima facie case of infringement, because Plaintiff was not doing anything that infringed the patent. If Hall is right his own testimony shows that he did what Defendant is now doing at a date early enough to anticipate the patent. Therefore, Plaintiff's patents cannot be upheld. In reply, page 65, Mr. Whitcomb stated that Shimadzu was entitled by reason of his 1920 application 431,473, to a date sufficiently early to avoid anticipation of the patent in suit. The Court then remarked that if Shimadzu was entitled to that

early date Defendant's argument was destroyed. The slightest glance at the certified copy of that application shows that Mr. Whitcomb's contention is without foundation. Hall's testimony is competent to show admissions made by him in another suit but it certainly is not conclusive against him or the Defendant and does not constitute an estoppel. It is inconceivable that Hall's testimony can be viewed as establishing even a prima facie case of infringement, in favor of Shimadzu, who was a party to the Patent Office proceedings, and who established by testimony not only that Hall was wrong, but also the impossibility of making suboxide of lead and thereby infringing Plaintiff's patent by Hall's process in a Hardinge mill; and in the Patent Office proceedings it was established that Hall operated with a Hardinge mill. Shimadzu having defeated the right to patent the suboxide matter of Shimadzu's patent 1,584,150, which Hall was asserting in the Patent Office, by successfully contradicting Hall's testimony and affirmatively showing that Hall was mistaken or wrong and that Hall never had and could not have lead suboxide, cannot now say that Hall's same testimony is proof of infringement of that lead suboxide patent. Hall's testimony was either right or wrong, and not both, and Shimadzu having by testimony in the Patent Office established that Hall's testimony was wrong, cannot in this Court say that Hall's same testimony is right.

In these circumstances, and in its efforts to make a prima facie case or showing of infringement, Plaintiff asks this Court to overrule the Supreme Court of the United States in Morgan vs. Daniels, 153 U. S. 121, and to reverse the decision made in the Patent Office and affirmed by the Court of Customs and Patent Appeals between the same parties, and further Plaintiff asks this Court to accept Hall's discredited testimony as establishing a prima facie case of infringement of

Plaintiff's suboxide patent, and Plaintiff further asks this Court to read into the 1920 application, Ser. No. 431,473, the lead suboxide invention which is obviously absent from it.

We confidently submit that this Court in the exercise of its discretion should decline to comply with Plaintiff's request, especially in view of the fact that Plaintiff is a competitor newly arrived in the field long occupied by Defendant, and of the further fact that Plaintiff is now posing as a suitor.

Respectfully submitted,

HUGH M. MORRIS,
AUGUSTUS B. STOUGHTON,
A. F. KWIS,
E. S. W. FARNUM, JR.

NOTICE OF DEFENDANT'S MOTION FOR BILL OF PARTICULARS.

(Filed June 8, 1935.)

Please take notice that on the 12th day of June, 1935, at ten o'clock in the forenoon, or as soon thereafter as counsel can be heard, at the United States District Court for the Eastern District of Pennsylvania, at the Post Office Building, 9th & Chestnut Streets, City of Philadelphia, State of Pennsylvania, the attached Motion will be presented.

AUGUSTUS B. STOUGHTON,
E. S. W. FARNUM, JR.,
HUGH M. MORRIS,
Solicitors and of Counsel for Defendant.

To:

Joseph Henderson, Esq.,
Rawle & Henderson,
Packard Building,
Phila., Pa.,
Solicitors and of Counsel
for Plaintiffs.

DEFENDANT'S MOTION FOR BILL OF PARTICULARS.

(Filed June 8, 1935.)

And now comes the defendant, The Electric Storage Battery Company, and moves, pursuant to Equity Rule 20, and pursuant to a stipulation of counsel extending the time of either party to take depositions or testimony or to move for further and better statement of the nature of the claim or defense or of any matter stated in any pleading under Rule 20, or to file interrogatories under Rule 58, to and including June 30, 1935, that the plaintiffs be ordered to furnish a further and better statement of the nature of their claim as set forth in their Bill of Complaint in the following respects:—

1. By setting forth or specifying the claim or claims of each of plaintiffs' patents relied upon as having been infringed by the defendant.

2. By setting forth more definitely and furnishing particulars describing the steps in the process of defendant on which the plaintiffs will rely at the trial to establish infringement.

3. By setting forth definitely or describing the

parts or elements of defendant's apparatus that the plaintiffs will rely upon at the trial to establish infringement of the apparatus claimed:

All for the reason that the statements in the Bill of Complaint are so vague and indefinite that the defendant cannot intelligently prepare its defense thereto. And defendant moves that such order as to costs may be made herein as may be just.

Bill of Particulars to be filed on or before June 24, 1935.

E. S. W. Farnum, Jr.,
Augustus B. Stoughton,
Hugh M. Morris,
Solicitors and of Counsel for Defendant.

NOTICE OF MOTION FOR LEAVE TO FILE INTERROGATORIES.

(Filed June 8, 1935.)

Please take notice that on the 12th day of June, 1935, at ten o'clock in the forenoon, or as soon thereafter as counsel can be heard, at the United States District Court for the Eastern District of Pennsylvania, at the Post Office Building, 9th & Chestnut Streets, City of Philadelphia, State of Pennsylvania, the attached Motion will be presented.

E. S. W. Farnum, Jr.,
Augustus B. Stoughton,
Hugh M. Morris.

To:

Joseph Henderson, Esq.,
Rawle & Henderson,
Packard Building,
15th & Chestnut Sts.,
Phila., Pa.,
Solicitors and of Counsel
for Plaintiffs.

DEFENDANT'S MOTION FOR LEAVE TO FILE INTERROGATORIES AFTER EXPIRATION OF TWENTY-ONE DAYS.

(Filed June 8, 1935.)

Now comes the defendant in the above entitled cause and asks leave of court to file interrogatories in writing hereto annexed to be answered by the plaintiff, an officer of the Northeastern Engineering Corporation, and if Genzo Shimadzu is out of this country, by his attorney in fact or authorized representative, if any, in this country under oath.

The reason why said interrogatories were not filed before is that by stipulation of solicitors and counsel the time to file interrogatories under Rule 58 was extended to and including June 30, 1935.

AUGUSTUS B. STOUGHTON,
E. S. W. FARNUM, JR.,
HUGH M. MORRIS,
Solicitors and of Counsel for Defendant.

Dated:
June 6, 1935.

INTERROGATORIES PROPOUNDED BY DEFENDANT.

(Filed June 8, 1935.)

Interrogatories propounded by the defendant pursuant to Equity Rule 58 and to be answered by an officer of the Northeastern Engineering Corporation, and if Genzo Shimadzu is out of this country, by his attorney in fact, or authorized representatives, if any, in this country, under oath.

Interrogatory No. 1. State whether or not Genzo Shimadzu, the plaintiff above named, and the patentee of the United States patents in suit, is the same individual to whom issued the Japanese and British patents referred to and set forth on pages 10, 11 and the top of page 12 of defendant's printed answer.

Interrogatory No. 2. State whether or not the translations of said Japanese patents heretofore submitted to counsel for plaintiff by counsel for defendant are substantially correct.

Interrogatory No. 3. If the answer to Interrogatory No. 2 is in the negative state wherein said translations are not substantially correct in plaintiffs' opinion.

Interrogatory No. 4. State whether the conceptions of the inventions of the respective patents in suit occurred in a country foreign to the United States.

Interrogatory No. 5. If the answer to Interrogatory No. 3 is in the affirmative, state the dates when the inventions of the respective patents in suit were first communicated to someone in the United States.

Interrogatory No. 6. State the dates of the inventions of the several patents in suit.

The plaintiffs are required to answer these interrogatories on or before June 24, 1935.

E. S. W. Farnum, Jr.,
Augustus B. Stoughton,
Hugh M. Morris,
Solicitor and of Counsel for Defendant.

Dated:

June 7, 1935.

INTERROGATORIES PROPOUNDED BY PLAINTIFFS, PURSUANT TO EQUITY RULE 58, TO BE ANSWERED BY THE OFFICER OF THE DEFENDANT, ELECTRIC STORAGE BATTERY COMPANY MOST FAMILIAR WITH THE FACTS, UNDER OATH.

(Filed June 22, 1935.)

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1. State whether or not at the bottom of the bag collector where the material is transferred to the screw conveyor, there is a rotary gate valve at Point A marked on the accompanying drawing S. B. 26478-1.

2. Please state the same thing with respect to Point B and B′ at the bottom of the cyclone separator.

3. With respect to the bucket conveyor connection to the entrance end of the Hardinge Mill, please state whether or not there are any gates at the zone "C" to prevent air coming in the inlet pipe containing the Pitot tube and passing down the chute containing the bucket conveyor.

4. Please state whether or not the feed valve has

been used continuously for six years prior to the filing of the bill of complaint herein, when the automatic feeding devices were used, or when fed by hand.

5. How long has defendant used the Pitot tube in the inlet pipe, or any other means for measuring the volume of air entering the mill, as shown on the drawing SB 26478-1. Particularize with respect to such uses and types, if any other type than the Pitot tube has been used.

6. In connection with Patent No. 1584479 please state whether or not defendant has within six years prior to the filing of the bill of complaint herein, mixed or kneaded powder formed from the metallic lead by the process employed by defendant, using the apparatus illustrated in the drawing attached to or described in the report of Dr. Wilson, with a liquid to form a paste for storage battery places. If so give the proportions of all materials used to form the paste.

7. If your answer to the foregoing interrogatory is "yea", please state whether defendant within six years prior to the filing of the bill of complaint herein, applied the paste thus formed to the grids for storage batteries.

8. In connection with Patent 1584152, please state whether or not defendant for six years prior to the filing of the bill of complaint herein has used and or sold any products manufactured by the apparatus shown in the drawing attached to Dr. Wilson's report or described by Dr. Wilson in his report, for paints or paint pigaments.

RAWLE & HENDERSON,
HUNT, HILL & BETTS,
EDMUND B. WHITCOMB,
Solicitors for Plaintiffs.

Dated, June, 1935.

MOTION FOR FURTHER AND BETTER PARTICULARS OF DEFENSES.

(Filed July 9, 1935.)

And now comes plaintiffs by their counsel and move for an order requiring the defendant, on or before the day of July, 1935, to file further and better particulars of the defenses in the answer herein, as follows:

1. What United States and/or foreign patents and what United States and/or foreign publications will be offered in evidence at the trial of this cause:

(a) to illustrate the prior state of the art;

(b) for the purpose of anticipation of any claim of any of the patents in suit;

(c) for any other purpose.

(d) Point out as to each of the items (a), (b) and (c) with respect to each claim of the several patents in suit as specified by plaintiffs as the claims upon which plaintiffs will rely.

2. State each instance upon which defendant will attempt to prove on the trial of this cause:

(a) As to any alleged prior knowledge or use as alleged in ¶ 23 and 260y the answer and point out the same as against each claim in suit of each patent in suit.

(b) As to any alleged independent invention or inventions as alleged in the last four lines of paragraph 23 of the answer or otherwise, and particularize with respect to each claim in suit of each patent in suit.

(c) As to any alleged prior use in the United States for more than two years prior to the application date of any and/or all of the patents in suit and particularize with respect to each claim in suit of each patent in suit.

In connection with the foregoing sub-divisions (a), (b) and (c) furnish plaintiffs with:

(1) All blue prints to scale of each such installation upon which defendant will rely at the trial of this cause, particularly including the alleged 1916, 1918 and 1920-21 instances referred to in the various affidavits heretofore filed in this cause.

(2) All descriptive matter in detail as to the construction of each feature of, and all operating data and each process step relating to the operation of each alleged prior use upon which defendant will rely at the trial of this cause in support of any defense of prior knowledge and/or use.

(3) Information stating within whose knowledge said alleged prior use for more than two years prior to the applications for the patents in suit occurred, stating specifically where (street address, town and state) and day when such alleged prior knowledge and/or use occurred, particularizing with respect to each and every instance upon which defendant will rely on the trial of this cause.

3. As to paragraph 23 of the answer, particularize in detail upon what facts, etc., defendant will rely at the trial to show that it "required no invention" to produce the improvements, being specific as to each

patent in suit relied upon by plaintiffs, and likewise as to defendant's proofs that the same "were not patentable invention or improvement within the meaning of the law".

4. As to paragraph 25 of the answer, particularize specifically as to each claim in suit of each patent in suit, stating which foreign patent or patents giving country, number of such foreign patent or patents, date of issuance and date of filing, "by said Shimadzu" upon which defendant will rely at the trial, and which it claims render each patent "null, void and invalid" as alleged.

5. (a) Specify in detail upon what different patents, United States and foreign, and/or publications, defendant will rely at the trial as against each claim in suit of each patent in suit.

(b) If more than one prior art item will be urged against any one claim, state in particular whether defendant intends to use the same separately or combined, and if combined specify how defendant proposes to combine the same as against each such claim.

Bill of Particulars to be filed on or before July 1935.

RAWLE & HENDERSON,
HUNT, HILL & BETTS,
Solicitors for Plaintiffs.

E. B. WHITCOMB,
Of counsel.

DEFENDANT'S BILL OF PARTICULARS.
(Filed Aug. 29, 1935.)

Defendant herein, by its attorneys—Hugh M. Morris, Edward S. W. Farnum, Jr. and Augustus B. Stoughton, for further and better particulars, says:

1. As at present advised, see printed answer Section S 25 and 26 and Schedule A, also the patents mentioned in (a) below.

(a) Starting with Hyde on page 12 of the printed answer through page 15 thereof and Section 26 of the answer and in addition

British patent #4809 of 1882 to Tathani et al for improvements in secondary batteries.
U. S. patent #266,762 of October 31, 1882 to C. F. Brush.
U. S. patent #849,555 of April 9, 1907 to Montgomery.

(b) See answer to (1)

(c) All of the foreign patents to Shimadzu set up in the answer, plus Canadian patent 243,794 of October 21, 1924, filed February 19, 1923.

(d) See answer (a) as to each of the claims in suit. As to (b) under (d) the Hyde British patent #19981 as to patent 1,584,149, claims 1 and 2, U. S. patent 1,584,150, claims 1, 2, 3, 4 and 11, U. S. patent 1,584,151, all claims.

British patent 14,794 to Coleman, claims 14, 15, 16 and 17 of 1,584,150.
Bischof British patents 13,202 of 1898 and 11,602 of 1890, U. S. patent 1,584,150, claims 15, 16 and 17.

U. S. patent 846,384, 1907, to Bailey. Claims 1 and 2 of 1,584,149. All claims in suit of #1,584,150 and in connection with patent 846,444 referred to therein, claim 1 of 1,584,151 and claims 1 and 2 of 1,584,152.

Thibault U. S. patent #1,482,327, 1924, and French patent 494,270 of 1919, claims 9, 10, 11, 12 and 13 of patent 1,584,150.

Belgian patent 284,885 and publication thereof in 1920, claim 1 of 1,584,149, claims 1, 3, 4, 6, 8, 9, 10, 11, 12, 13, 14, 15, 16 and 17 of 1,584,150. All claims in suit except 5, that is claims 1 to 4 of 1,158,151.

U. S. patent 645,978 to Silvey against all the claims of 1,584,479.

U. S. patent 723,327 to Sperry, claims 1, 2, 3, 4, of 1,584,479

Akkumulatoren Und Galvanischen Elemente by Dr. L. Lucas as to all claims 1,584,479.

Answering (c) under (d), 1,584,149 is invalid under Section 4886, R. S. on Japanese patents 41,728 and 42,563 as to both claims.

U. S. patent 1,584,150, all claims in suit invalid on Japanese patents 41,728, 42,562 and 42,563.

U. S. patent 1,584,151, all claims in suit invalid on Japanese patent 41,953 and on Canadian patent 243,794.

U. S. patent 1,584,152, all claims invalid on Japanese patent 40,704.

U. S. patent 1,584,479, all claims in suit invalid on Japanese patents 42,861 and 42,862.

U. S. patent 1,584,151, all claims in suit invalid on British patent 176,924.

U. S. patent 1,584,150, all claims invalid on British patent 197,031.

NOTE. The above answers are made in the light of the translations of the Japanese patents now in possession of defendant and which were submitted sometime ago to plaintiff for an expression of views which however at the date hereof has not been forthcoming.

(2) Answering (a) and (b), all patents and public uses set up in the answer except the Shimadzu patent.

Answering (c) as to prior use applied to each claim of each patent in suit, see answer to interrogatory #1.

Answering Section 1 under interrogatory 2, blueprints identified as follows are submitted herewith:

AFA 14-311, 6-11-12
A-328 July 24, '16
SB-288-2 September 25, 1915
SB-286-2 March 23, 1916
SB-201 March 11, 1915
SF-2427-1 November 14, 1920

Answering paragraph 2 under interrogatory 1 and as at present advised, there is submitted herewith copies of typical records dated August 3, 1916, also August 4, 1916 and August 7, 1916, also lead dust manufacture Kershaw to Willard Company dated July 24, 1917, also Smith to Norberg dated October 3, 1919, also all records prior to July 14, 1921, log sheets beginning February 11, 1921, for every day the mill was run, of which 1 typical sheet dated April 13, 1921 is produced.

NOTE: Defendant's process is not a step process. It is a continuous unitary process.

Answering interrogatory 3, among others Edward Wanton Smith, 535 Church Lane, Philadelphia, William Ernest Kershaw, Gwynedd Valley, Montgomery County, Clarence A. Hall, 7951 Winston Road, Chestnut Hill, Philadelphia, Benjamin Shablin, 3858 Penns Grove Street, Philadelphia, John D. Kohl, 54 West Johnson Street, Philadelphia, Pennsylvania, W. L. Reinhardt, 246 East 131 Street, Cleveland, Ohio. The uses occurred at 19th Street and Allegheny Avenue, Philadelphia, Pennsylvania, and at 246 East 131st Street, Cleveland, Ohio on days too numerous to mention from 1907 in one case and from 1920 in the other case.

Answering interrogatory 3, the whole prior art set up in this case as to each claim in suit of each patent in suit.

Answering interrogatory 4 and as at present advised 1,584,149 both claims on Japanese patent applied for November 21, 1920, issued February 13, 1922, #41728 and 42563 applied for November 27, 1920, issued May 10, 1922.

1,584,150, all claims in suit, Japanese patents 41,728 filed November 21, 1920, issued February 13, 1922, 42,562 filed November 27, 1920, issued May 10, 1922, 42,563 applied for November 27, 1920, issued May 10, 1922. British patent 197,031 filed February 7. 1922, issued May 7, 1923.

1,584,151, Canadian patent filed February 19, 1923, issued October 21, 1924 #243,794, Japanese patent 41,953 August 29, 1920, issued March 10, 1922.

1,584,479, Japanese 42861-2 patent filed August 3, 1921, issued June 17, 1922, Japanese patent 41,728 filed November 21, 1920, issued February 13, 1922 and Japanese patent 42,563 filed November 27, 1920, issued May 10, 1922.

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Answering interrogatory 5, (a) and (b), see answers to interrogatory #1.

AUGUSTUS B. STOUGHTON,
HUGH M. MORRIS,
E. S. W. FARNUM, JR.,
Attorneys for Defendant.

ABS:C
8-20-35

ANSWERS TO INTERROGATORIES.

(Filed Aug. 29, 1935.)

EASTERN DISTRICT OF PENNSYLVANIA, }
CITY AND COUNTY OF PHILADELPHIA. } *ss.*

R. C. NORBERG, having been duly sworn, says that he is Vice-President of the Defendant and that he makes the following answers to interrogatories propounded to the defendant in the above entitled case, to be answered by the officer of the defendant most familiar with the facts:

1. The answer to interrogatory 1 is "yes".

2. Answering interrogatory 2, the answer is "yes".

3. Answering interrogatory 3, the answer is "there is no valve and there is no appreciable flow of air in the chute containing the bucket conveyor".

4. Answering interrogatory 4, the answer is "a feed valve has been continuously used for 6 years prior to the filing of the bill of complaint herein".

5. Answering interrogatory 5, the answer is "a

pitot tube in the inlet pipe has been exclusively used since about March, 1921, in measuring the volume of air entering the mill".

6. Answering interrogatory 6, the answer is "yes". The proportions are 300 grams of powder and from 34 to 40 c. c. of water".

7. Answering interrogatory 7, the answer is "yes".

8. Answering interrogatory 8, the answer is "no".

R. C. NORBERG.

Sworn to and subscribed before me
this 29th day of August, 1935.

MURIELL T. CRANMER,
(SEAL) *Notary Public.*
My Commission Expires March 5, 1937.

AUGUSTUS B. STOUGHTON,
HUGH M. MORRIS,
E. S. W. FARNUM, JR.

ANSWERS OF NORTHEASTERN ENGINEERING CORPORATION and GENZO SHIMADZU, TO THE INTERROGATORIES ADDRESSED TO THE PLAINTIFFS BY DEFENDANT.

(Filed Sept. 13, 1935.)

ANSWER TO INTERROGATORY No. 1:

Genzo Shimadzu, one of the plaintiffs herein and patentee of the United States patents in suit, is the

same individual to whom were issued the Japanese and British patents referred to and set forth on pages 10, 11 and to of page 12 of defendant's printed answer.

ANSWER TO INTERROGATORIES Nos. 2 and 3:

The translations of the Japanese patents submitted to counsel for plaintiffs by counsel for defendants are substantially correct, subject to the following corrections:

Japanese Patent No. 42563:

(a) Page 2, line 6:

The words "tubes" and "them" should read: "pipe" (singular) and "it".

(b) Page 2, lines 11 and 18:

The words "(approximately 22 pounds)" should be stricken out.

(c) Page 2, lines 16 and 17:

The words "by the circulating air" should be stricken out.

(d) Page 3, line 11:

The words "(of the air)" should be stricken out.

Japanese Patent No. 60825:

(a) Page 2, last four lines:

The words following the semi-colon, reading: "and when it is supplied to the paste material for electrodes of storage batteries in the state of lead peroxide or litharge made by oxidizing it in this way, the results are very good."

should read:

"when the material is further oxidized in this way forming lead peroxide or litharge and it is supplied as the paste material for electrodes of storage batteries, the results are very good."

(b) Page 3, line 7:

Correct the spelling of "kwans".

(c) Page 3, line 8:

The words "(about 207 pounds)" should be stricken out.

(d) Page 3, line 12:

After the word "degrees" the word "centigrade" should be inserted.

(e) Page 3, line 21:

The word "or" should be changed to "and".

(f) Page 3, line 21:

After the word "oxidizing" the word "gas" should be inserted.

(g) Page 3, lines 30 to 34 inclusive:

The sentence beginning with the word "Presumably" and ending with the word "suboxide" should be stricken out and the following substituted therefor:

"Presumably as compared with these patented inventions the present invention accelerates the grinding action and very greatly increases the manufacturing efficiency of the product by especially maintaining the metallic lead material at the proper temperature during the formation of lead suboxide

Japanese Patent No. 41728:

(a) Page 2, line 14:

The words "33 ounce (250 monme)" should be stricken out and the words "250 kwans of" substituted therefor.

(b) Page 2, line 19:

Correct the spelling of "kwāns".

(c) Page 2, line 19:

The words "(12 pounds)" should be stricken out.

(d) Page 2, line 27:

The word "tube" should read "vessel".

(e) Page 3, line 10:

The words "in lead oxide" should be stricken out.

(f) Page 3, line 11:

The words "such as" should be inserted before the word "litharge" at the beginning of the line.

(g) Page 3, line 11:

The words "and paint material" should be inserted after the word "batteries".

(h) Page 3, line 13:

The word "contact" should read "catalytic".

Japanese Patent No. 41953:

(a) Page 1, line 13:

The word "having" should read "has".

(b) Page 1, line 14:

The words "is very rough because of such" should read "and has".

(c) Page 2, last line:

The words "bake or heat" should read "melt or roast".

(d) Page 3, lines 12 and 17:

The word "baking" should read "roasting".

Japanese Patent No. 42562:

(a) Page 1, 1st paragraph, line 6:

The word "forcing" should read "freely discharging".

(b) Page 2, line 3:

The word "forced" should read discharged".

(c) Page 2, line 9:

Correct the spelling of the word "kwans".

(d) Page 2, lines 9 and 10:

The words "(206-2/3 pounds)" should be stricken out.

(e) Page 2, line 16:

Correct the spelling of the word "kwans".

(f) Page 2, lines 16 and 17.

The words "(approximately 16.5 pounds)" should be stricken out.

(g) Page 2, next to last line:

The word "expulsion" should read "discharge".

(h) Page 3, last line:

The word "expelled" should read "discharged".

Japanese Patent No. 42564:

(a) Page 2, lines 1 and 6:

The word "copper" should read "steel".

(b) Page 2, lines 2 and 9:

Correct the spelling of the word "kwans".

(c) Page 2, lines 2 and 3:

The words "(206-2/3 pounds approximately)" should be stricken out.

(d) Page 2, line 9:

The words "(24.8 pounds about)" should be stricken out.

Japanese Patent No. 42861:

(a) Page 1, line 4 from bottom:

The word "it" should be stricken out.

(b) Page 1, line 3 from bottom:

The word "through" should read "though".

(c) Page 1, line 3 from bottom:

The words "it were" should be inserted after the word "through" (though).

Japanese Patent No. 42862:

(a) Page 1, line 5 paragraph 1:

The letter "d" should be stricken out of the word "liked".

(b) Page 1, line 2, paragraph 2:

The word "kneating" should read "kneading".

(c) Page 1, line 3, last paragraph:

The word "grinded" should read "ground".

(d) Page 1, line 5, last paragraph:

The word "Kneat" should read "Knead".

(e) Page 2, paragraphs numbered "1.)" and "2.)" should be stricken out and the following substituted therefor:

"1. In order to accomplish the object above described, a process of manufacturing storage battery plates characterized by filling the grid plates with a paste prepared by using metallic lead powder of fine state, possessing a pyrophoric nature and an apparent specific gravity of below 3.0; which is produced by a mechanical abrasion instead of using ordinary oxide of lead and eliminating the necessary formation procedure.

2. In order to accomplish the object above described, storage battery plates as described in above paragraph characterized by effecting the formation procedure during the initial charging operation after drying of the plates filled with the paste prepared by kneading of fine metallic lead powder with a liquid which produces no injury to the storage battery, such as water or dilute sulphuric acid."

Japanese Patent No. 45093:

(a) Page 1, 1st paragraph, line 3:

The word "amorphous" should be inserted between the words "fine" and "powdered".

(b) Page 1, 1st paragraph, line 4:

The words "light in character and is" should be stricken out.

(c) Page 1, 1st paragraph, line 6:

The word "painting" should read "spreading".

(d) Page 1, 2nd paragraph, line 4:

The word "paint" should read "spread".

(e) Page 2, line 1:

The word "the" should read "an".

(f) Page 2, line 2:

The word "finely" should read "fine".

(g) Page 2, line 2:

The word "amorphous" should be inserted before the word "powder".

(h) Page 2, line 3:

The word "of" should be inserted at the beginning of the line.

(i) Page 2, line 3:

The words "light in character" should be stricken out.

(j) Page 2, 2nd paragraph:

The paragraph beginning with the words "The lead suboxide" and ending with the words "this invention" should be stricken out and the following substituted therefor:

> "The lead suboxide used in this invention is in a very fine amorphous state and is produced by mechanical abrasion. Its principal constituent is composed of lead suboxide but owing to the nature of manufacturing process, it may possibly contain 1 to 40% of metallic lead powder and it may also include forming lead oxides which in accordance with the nature of lead suboxide oxidizes into a monoxide during the manufacture or when left in the atmosphere, but the product can be used in this invention without difficulty. That is, the lead monoxide produced by the oxidation of lead suboxide under room temperature possesses the same state of apparent specific gravity as that of the original material, lead suboxide, but differs in characteristics from a lead monoxide produced by fusing of lead and hence it produces plates of great durability and rich activity since it readily solidifies due to the action with water. Therefore even if the original material, lead suboxide contains other oxidized substances produced by slow oxidation during the storing they do not interfere with the practice of the present invention."

(k) Page 3, lines 6 and 8:

The word "transformation" should read "formation".

(l) Page 3, line 12:

The word "light" should read "amorphous".

(m) Page 3, line 3 from bottom:

The word "painted" should read "spread".

(n) Page 4, line 3:

The word "painting" should read "spreading on".

(o) Page 4, line 5:

The words "light in character" should read "amorphous".

(p) Page 4, line 2 from bottom:

The figure "10" should read "1".

ANSWER TO INTERROGATORY NO. 4:

Yes, in Japan.

ANSWER TO INTERROGATORY NO. 5:

Unable to answer this interrogatory at this time for lack of knowledge or information sufficient to form a belief.

ANSWER TO INTERROGATORY NO. 6:

In connection with the patents in suit relied upon by plaintiffs, plaintiffs will rely on the dates of conception in the early part of 1918; upon drawings dated in September, 1918, showing the first stages of the development of the inventions; on drawings dated in December, 1918, showing the inventions, and on various drawings and sketches in the spring of 1919, and on other drawings at other dates therebetween and in the summer of 1919; for a reduction to practice the construction of machines in January, 1919, successful operation thereof in the spring of 1919 and further machines embodying the inventions constructed upon a commercial scale in the summer of 1919.

Interrogatories have been addressed to Mr. Shimadzu under letters rogatory, requesting testimony as to these facts.

RAWLE & HENDERSON,
Packard Building,
Philadelphia, Pennsylvania,

HUNT, HILL & BETTS,
120 Broadway,
New York City, New York,

EDMUND B. WHITCOMB,
Ohio Bank Building,
Toledo, Ohio,
Solicitors for Plaintiffs.

L. S. ISHIMURA.

SOUTHERN DISTRICT OF NEW YORK }
CITY COUNTY AND STATE OF NEW YORK } *ss:*

L. S. Ishimura, being duly sworn, deposes and says that he is the authorized representative of Genzo Shimadzu, one of the plaintiffs herein, in this country; that said Genzo Shimadzu is not within the United States; that he has read the foregoing answers to interrogatories and that the same are true to the best of his knowledge, information and belief.

L. S. ISHIMURA.

Sworn to before me this
18th day of Sept., 1935.

TERESA DABBOWSKI,
Queens County Clerk's No. 297.
Queens County Register's No. 155.
New York County Clerk's No. 42.
New York County Register No. 6-D-25.
Commission expires March 30, 1936.
(Seal)

PLAINTIFFS' BILL OF PARTICULARS.

(Filed September 19, 1935.)

The plaintiffs herein, by their attorneys, Rawle & Henderson, Hunt, Hill & Betts, and Edmund B. Whitcomb, for further and better particulars, say:

1. No. 1584149—both claims.
1584150—claims 1—4 each inclusive; 6; 8-17 each inclusive.
1584151—claims 1-5 each inclusive.
1584152—As at present advised we will not rely on any claim of this patent in view of defendant's answer to plaintiffs' interrogatory No. 8.
1584479—claims 1-4 each inclusive.
1896020—claims 10 and 11.

2. As at present advised, and without admitting the right of the defendant to ask for the further particulars contained in 2, and excepting to such demand, and reserving their exception and objection, plaintiffs state that the steps of the process of defendant on which plaintiffs will rely at the trial to establish infringement more particularly include steps of introducing raw lead into a revolving vessel and forming metallic lead powder, lead suboxide and litharge and/or a combination of any of them as a primary and/or secondary stage of the various processes and reactions taking place in defendant's apparatus, as illustrated in the drawing SB 26478-1 attached to Dr. Wilson's report made under order of Court herein and/or as described in the operation of said apparatus as contained in said report, subject to correction should error subsequently appear at the trial or other steps or processes, as may be shown to have been used by defend-

ant within the period of six years prior to the filing of the bill of complaint.

3. As at present advised, and without admitting the right of the defendant to ask for the further particulars contained in 3, and excepting to such demand, and reserving their exception and objection, plaintiffs state that they will rely at the trial to establish infringement of the apparatus claimed, upon the apparatus used by defendant as illustrated in the drawing SB 26478-1 attached to Dr. Wilson's report made under order of Court herein and or as described in the operation of said apparatus as contained in said report, subject to correction should error subsequently appear at the trial, or other apparatus as may be shown to have been used by the defendant within the period of six years prior to the filing of the bill of complaint.

Dated, September 18, 1935.

RAWLE & HENDERSON,
Packard Building,
Philadelphia, Pa.,

HUNT, HILL & BETTS,
120 Broadway,
New York City, N. Y.,

EDMUND B. WHITCOMB,
Ohio Bank Building,
Toledo, Ohio,
Solicitors for Plaintiffs.

ORDER FOR LETTERS ROGATORY.
(Filed July 9, 1935.)

On the motion of the solicitors for the plaintiffs and after hearing counsel for the respective parties, it is

Ordered, that letters rogatory issue out of and under the seal of this Court, directed to the appropriate judicial authority in Japan, requesting it to cause to be called and summoned before it, or before such official as it may appoint, Genzo Shimadzu, Suyeharu Uchiyama and Tominosuke Hichijo of Kyoto, Japan, witnesses on behalf of the plaintiffs, to give evidence in the above entitled cause in answer to the written interrogatories of the plaintiffs and the cross-interrogatories of the defendant, if any there be attached to said letters rogatory; and it is

Further Ordered, that a translation of this order, of the letters rogatory and of the interrogatories and cross-interrogatories into the Japanese language shall be attached to said letters rogatory; and it is

Further Ordered, that all objections, except as to the form of the questions, are reserved until the trial, and that Rawle & Henderson or Hunt, Hill & Betts, solicitors for the plaintiffs are authorized to withdraw the return to the letters rogatory from the files of the Court when the same may have been received from Japan, after having them photostated under directions of the Clerk for the purpose of making translations thereof, and shall thereupon serve copies thereof upon the solicitors for the defendants, and that the fees in connection with said letters rogatory and of the stenographer and interpreter, if any, be taxable as disbursements herein.

W. H. KIRKPATRICK,
U. S. D. J.

July 3, 1935.

ORDER OF AMENDMENT.
(Filed September 23, 1935.)

On consent of the parties hereto, it is

Ordered, that the third paragraph of the order of this court entered herein on July 3, 1935, providing for the issuance of letters rogatory in Japan to take the testimony of Genzo Shimadzu, Suyeharu Uchiyama and Tominosuke Hichijo of Kyoto, Japan, be modified and amended so as to read as follows:

> "Further Ordered that a translation of this order and of the letters rogatory into the Japanese language shall be attached to said letters rogatory, but that a translation of the interrogatories and cross-interrogatories need not be attached, and that the testimony of the witnesses may be taken through an interpreter, the questions being interpreted and addressed to the witnesses in Japanese and the answers received in Japanese, interpreted and taken down in English."

W. H. KIRKPATRICK,
U. S. D. J.

We hereby consent to the entry of the foregoing order.

RAWLE & HENDERSON,
HUNT, HILL & BETTS,
Solicitors for Plaintiffs.

E. S. W. FARNUM, JR.,
AUGUSTUS B. STOUGHTON,
HUGH MORRIS,
Solicitors for Defendant.

NARRATIVE STATEMENT OF EVIDENCE.

BE IT REMEMBERED that at the trial of the above-mentioned cause, before the Honorable William H. Kirkpatrick, District Judge for the Eastern District of Pennsylvania at Easton, Pennsylvania, begun September 25, 1935, the following proceedings were had and evidence introduced which is hereby reduced to narrative form pursuant to Equity Rule 75.

The plaintiffs appeared by Edmund B. Whitcomb, Esq., Joseph W. Henderson, Esq., George Whitefield Betts, Jr., Esq., George Yamaoka, George H. Souther and Carl F. Schaffer, as counsel.

Defendant appeared by Hugh M. Morris, Esq., A. B. Stoughton, Esq. (and E. S. W. Farnum, Jr., Esq.) and A. F. Kwis, Esq., as counsel.

PLAINTIFF'S EVIDENCE.

Counsel for plaintiffs offered in evidence as Plaintiffs' Exhibit 1, Patent No. 1,584,149, Patent No. 1,584,150, Patent No. 1,584,151, Patent No. 1,584,152, Patent No. 1,584,479, Patent No. 1,896,020, which were received in evidence and marked "Plaintiffs' Exhibit 1".

Counsel for Plaintiffs thereupon offered the following documents which were received in evidence and marked as indicated:

Certified copy of file wrapper, Patent No. 1,574,149, Plaintiffs' Exhibit 2.

Certified copy of file wrapper, Patent No. 1,584,150, Plaintiffs' Exhibit 3.

Certified copy of file wrapper, Patent No. 1,584,151, Plaintiffs' Exhibit 4.

Certified copy of file wrapper, Patent No. 1,584,479, Plaintiffs' Exhibit 5.

Certified copy of file wrapper, Patent No. 1,896,020, Plaintiffs' Exhibit 6.

THE COURT: These were not all on the same day.

MR. WHITCOMB: No, you are right.

THE COURT: The first five were all issued—

MR. WHITCOMB: Yes.

THE COURT: on the same day.

MR. WHITCOMB: Yes.

THE COURT: All right.

MR. WHITCOMB: And as to the last one we rely upon the fact that it was filed before the others issued, and as for common subject matter we contend for our right to go back to the early date.

THE COURT: All right.

L. S. ISHIMURA was called as a witness on behalf of the plaintiffs and having been first duly sworn, testified as follows:

Direct-examination.

By MR. WHITCOMB:

I am an employee of Nippon Denci Kabushiki Kaisha, which means Japan Storage Battery Corporation, of which Mr. Genzo Shimadzu, the patentee

of the patents in suit, is president. This company was organized in 1916, but I have known Mr. Shimadzu since 1906 and have been employed by him since 1906 or 1908 in the capacity of draftsman with the engineers.

In 1908, I was appointed by the Japanese Government as a student abroad here, and came to New York. I traveled all around and visited several factories, to see what the American Company does. That is all I did at that time. I took the mechanical engineering course at the Polytechnic Institute of Brooklyn and got an M. E. degree in 1916. After that I started to work for the Delavan Machine Company, making oil ranges, and for about four months thereafter I was with the Electro Galvanizing Company, Brooklyn, as a draftsman. In 1916, I went back to Japan and in October 1916 started to work with the Shimadzu Battery Corporation. I was head man in the Mechanical Engineering Department, and, of course, did everything for arrangement, the improvement of equipment, also made design of different kinds of batteries. I had contact at all times with Mr. Shimadzu, from whom I got instructions as to everything necessary to do, the most important thing to make some material for storage batteries.

MR. MORRIS: May it please Your Honor, may we object to any acts in the way of public use or any other acts done in a country other than the United States of America prior to a disclosure of the alleged invention of these patents or any of them in the United States?

THE COURT: Well, I will note the objection—

MR. MORRIS: Yes.

THE COURT: and take it subject to the equity rule.

MR. MORRIS: And may that objection stand throughout, without it being repeated?

THE COURT: Yes.

(The witness resuming testified):

Beginning with the year 1917 our company was buying oxide from other makers but the materials were not reliable, some times containing impurities and could not make good batteries, so Mr. Shimadzu wanted to try to make his own oxide factories, spending maybe fifty or sixty thousand dollars, but it is a very difficult thing to get ideal material for storage batteries so Shimadzu's original idea was to make better powder from metallic lead. He did not have in mind any apparatus but fortunately he had another company he was dealing with which had experience making the material for grinding china, stones, pottery industry work. Shimadzu had the idea of using apparatus used for pottery material. I can show you my notes describing experiments, what we used and everything else. This is a note I have written. I took notes day by day as the experiment progressed and here is one picture, we first used for experiment, from our office, where they were producing china wares, the most famous place in Japan, with a State research department for the pottery industry. They have machines and Mr. Shimadzu and I went through and borrowed a pot mill, around the middle of September 1917. This is the blue print on page 3 from the inside cover of this book which I have produced. To describe the operation of these pot mills, we placed the lead balls in, but the abrasion with the pot mill was too high, so that the balls just crushed each other and did not produce powder, except that the balls became covered with some black

powder, but there wasn't any sign of making powder. Next we tried many experiments with pot mills, changing the size and regulating the speed to see how we might produce fine powders. This was in September 1917. We made about 300 experiments beginning in September 1917 and continuing for about three or four months, until we got the correct ideas, including the use of a blast of air.

By THE COURT:

"Q. Were you correct when you said 1917? If you look at the book—

A. Well, pardon me, it is 1918.

Q. 1918?

A. 1918, yes, I am sorry."

The date on the first page of the book I have in my mind is September 1918 which is the year I started.

Besides the pot mills, we made wooden drums with "rumba" boards, which were temporary, of course, as we had to have the material as soon as possible. "Rumba" boards are wooden boards, just the same as for cement. These are illustrated by the blue print that is on page 7 of this book which I have produced (Fig. 3 of Pl. Ex. 7a).

The blue print between those two is of a porcelain made pot mill. It is like the first blue print but a different size.

(At the suggestion of the Court counsel for plaintiffs here offered in evidence the book produced by the witness, as to which the witness testified: This book was copied from my notes under my supervision. The first book was completed in 1919; the last one in 1921. I have had charge of the book ever since and it is in the condition in which it was when finished in 1919.

Counsel for plaintiffs thereupon offered in evidence a second book produced by the witness, whereupon the following discussion took place:

MR. MORRIS: May I make an inquiry, Mr. Whitcomb? Your exhibit—number 7, is it?

MR. WHITCOMB: Yes.

MR. MORRIS: — purports to cover what period?

MR. WHITCOMB: September 1918 to July 1919.

MR. MORRIS: And your number—

MR. WHITCOMB: 8.

MR. MORRIS: Proposed number 8, purports to cover what period?

MR. WHITCOMB: July 1919 to March 1921.

MR. MORRIS: All right. I will not take the time to examine them in detail now, if I may pass that to a later moment, and reserve the objection, general objection which I made a moment ago as to matters having occurred in Japan.

THE COURT: Yes, sure.

The books produced by the witness were thereupon received in evidence and marked "Plaintiffs' Exhibit 7" and "Plaintiffs' Exhibit 8" respectively.)

(The witness resuming testified):

We finally found a way of using the rotary mill so we would get some fine powder from lead. Then we finally decided to construct a machine in actual size and operate on a commercial scale. In order

that you may possibly see that our process can operate on a commercial scale, I have here a drawing designed by me September 24, 1918, and traced by me, ordered by Mitsushi Company which is directly over the first company, in October 1918. All writings, everything, was done by me, September 24, 1918, to show the actual success or failure of the apparatus, we wanted to try it out on a big scale. The two white sheets attached at the corner is the certificate which we ordered as to what we did during that time, endorsed by the Mitsushi Company and certificate endorsed by the American Consul as to dates, etc., which you can see. The date of the endorsement of the United States Consul is 1933. That is the original drawing.

Counsel for plaintiffs thereupon offered in evidence the blue print produced by the witness which was received in evidence and marked "Plaintiffs' Exhibit 9.)

(The witness resuming testified):

The date on that is September 24, 1918. It appears in the right-hand corner on the very last line and is in Japanese. The drum illustrated in Exhibit 9 has a small opening in one portion to discharge the lead powder. We got a very coarse grained powder containing metallic lead. There was no means for admitting air in this drawing. We did not use this in commercial production. The product wasn't good enough to use for storage batteries. It was not abandoned, but we got only coarse grained powder which could not be used for storage batteries, although we changed the revolutions and put steel balls in and adjusted the amount charged, and all kinds of things for many days. The amount produced was

very small, perhaps five, ten pounds per hour, so that the only thing accomplished was to get something that couldn't be used, at the rate of five pounds per hour. In batteries the material and constituents must be very fine, and one day Mr. Shimadzu noticed that at the top of the bearing somewhere a very fine lead powder accumulated. In some way the air carried the powder which accumulated just like dust. It was his idea to use air to separate the fine powder from the metallic lead existing in the drums. On December 25th, he ordered me to make a drawing of such a mill. I drew this (the witness produced a drawing) and Mr. Shimadzu got a notary public to attach a certificate so he can get back to the date of invention, December 25, 1918. This drawing was originally drawn by me and traced with my help by a draftsman. The red writing is mine.

(Counsel for plaintiffs thereupon offered in evidence the December 1918 drawing, which was received in evidence and marked "Plaintiffs' Exhibit 10. Whereupon the following discussion took place:

By Mr. Morris:

Q. Have you the exact date in December on it?

A. There is a date on there.

Mr. Shaffer: The date of that is December 25th, 1918.)

(The witness resuming testified):

This tracing is made on the 26th but originally the 25th according to the certificate. Must be 25th, my date here is the 25th (discussion off the record). The original drawing was made the 25th, the tracing on the 26th. The blue prints and the white sheets

are the same. The two white sheets are also prints of the same tracing as the blue print. There is no difference between the two white sheets and the two blue prints, except that the original drawing is dated the 25th and the tracing the 26th.

Q. I notice that this says down here at the bottim 9-12-26.

A. Original drawing dated 25th, the tracing was made the 26th, that is why man put 26th.

Q. Sure, but what does the 9 mean?

A. 9 is Japanese September, 9 is September.

Q. What does the 12 mean?

A. 12, 12 means December.

Q. What does the 9 mean?

A. 12th of December, 1926. It is a 7.

Q. 7?

A. 7—1918.

Q. How does 7—explain to the Court how the 7 means 1918.

A. Well, you see, Japanese has a different year, as Emperor changes, therefore, you might repeat two years, two different years, the name of the year, the same year. When Emperor changes we start new number 1, start with the first year. That is the former Emperor's seventh year. That means 1918.

Q. When did that Emperor start to reign in Japan, do you know?

A. Ten years, this says ten.

Q. Present Emperor started ten years ago,—

A. Yes.

Q. — in 1925, and then the Emperor—

A. Yes.

Q. — before that,—

A. Yes, before that, sure.

Q. — do you know when he started? When did he start?

A. I don't know, former Emperor, Taisho, that is pretty near sixteen years.

Q. What we are trying to get at is how accurate you are, how you know—

A. Yes.

Q. — that is 1918.

A. Just plus one, see, Taisho, the former Emperior, year plus one.

Q. How do you know when the former Emperor started? Do you know that?

A. Well, Taisho—this is Showa, second Emperor.

Q. I know, to get back to the other Emperor, the one we are talking about—

A. I swear Taisho 7 means 1918, exactly.

Q. In Japan do they use 1935?

A. Don't use—

Q. Do they use the same—

A. Don't use—ordinarily we use the Japanese order of years. This is tenth year.

Q. And that is what you have on these drawings?

A. The drawing always shows the Japanese years, that is why, I can tell you exactly the months and days correctly, but when it comes to translate into ordinary old years, you got to have sense, you got to come out exactly, but I am sure Taisho 7 means 1918. I can prove that, this is Taisho, you see, this is Taisho, seventh year, that is what I call 1918.

MR. WHITCOMB: The witness refers to Exhibit number 7, front cover.

By MR. WHITCOMB:

Q. And what does it say in Japanese?

A. Taisho seventh, seventh year of Taisho.

Q. And you say that that is 19—what, 1918?

A. Yes, plus eleven years, seven plus eleven years, give you your years, you have eleven years plus, always, that convinced me exactly, Taisho 7 means 1918. It is exact, no mistake about it.

Q. Well, then, to get back to this drawing, which you say is made in December, 1918,—

A. Yes.

Q. —showing the air going into the drum,—

A. Yes.

Q. — please explain fully, now, how this compared with the other apparatus where you had no air going in the drum.

I must state to you that before this thing came, we used an ordinary fan, we got using a tube. We then tried to blow air, but in this case we had very much trouble in separating the air and how to collect the powder. You have to know how much air and what size of fan, and during those days we had great difficulty in finding how to feed the air and everything. Without tube feeding air it is very hard to blow out the powder unless you use much amount of air and high pressure.

And we finally abandoned that experiment, and Mr. Shimadzu started to use tubes, so that you can blow the air current directly upon the contents and powders, so that the powder got to go out.

Q. You wanted to be sure to get the air on the material, is that right?

A. Yes.

Q. And what did you do about it, this drawing here?

A. Well,—

Q. December, 1918.

A. We had a tube arranged inside, main tube and nozzles provided, and sent high pressure air, maybe two and a half pounds pressure, that is quite a good

pressure, and so at the same time we regulated the amount we charged and the number of revolutions, so as to give good oxidation of the contents, then air blowing inside some way, so we had very good resu t, that is, blow out just fine powder.

Of course, we had many difficulties, how to correct it. I can—I can tell it very in detail, but you can imagine how hard it was, in Japan, making this product, the amount of air, to separate the powder coming through, and you have to use some air to separate and collect it.

We had a drum in October, 1918, without any pipes. In December, we made this drawing with the pipes and continued to experiment. I made a drawing and Mr. Shimadzu's company made this part. Mr. Shimadzu has a machine shop where things can be made very quickly. You can see from the English translation of this exhibit how we proceeded.

Mr. Shimadzu told me to put in the pipes. All this work was done under the instruction of Mr. Shimadzu because I was employed by him and he supervised me in every way. We had the drawing done with the pipes in so you could put the air in December 25, 1918, when that drawing was made. Mr. Shimadzu then obtained a notary public's certificate. The apparatus was finished about March, 1919. It was exactly like this drawing, except that the drawing does not show the branch pipes. The branch pipes are shown in the drawing on page 5 of Exhibit No. 8. I do not have any large drawing like Exhibit No. 10. When Shimadzu told me to make it, I made it like this small drawing in the book, with short pipes. The apparatus that I am talking about was completed in March, 1919. We operated this machine with the air in various ways, adjusting the air pressure and amount, measuring the specific gravity of

the product, and what constituted it, by all sorts of experiments, continued a very long time, in order to find the correct amount of air going through, and what kind of powder we need, and all that sort, you know how difficult it is to get ideal material for storage batteries, it is the most difficult thing to do, especially the maker who is trying to get their own materials.

Q. What was accomplished by the introduction of the air, broadly, as compared with the previous apparatus where you said you had no air and got practically no material, and what you did get was no good?

A. Well, original idea was to get finest material from mills, with coarse material stayed in the material, just blow out fine material, so we can use batteries, that was the idea, but later we found the amount of product increases tremendously, after sending the air in.

Q. What was that due to, do you know?

A. Well, found oxidation was taking place.

Q. At first you thought you just wanted to blow the material out?

A. Yes.

Q. But when you found a tremendous oxidation took place, is that it?

A. That is right.

Q. And what happened?

A. Well, as the temperature go up, that means the lead when heated up to critical temperature becomes very brittle, and when you have oxidation present, also surface becomes very oxidized, so brittle you can scrape it very easily, produce fine powder, that was found, also, and under good conditions, this is the most ideal thing to do.

We tested it once to see what we would get without using any air. In that case we operated the machine nine or ten hours and obtained only a polished surface. There was not the slightest evidence of making powder. Here is a picture which shows how that thing looks. (The witness produced a picture.) The balls themselves got smooth and shiny but produced no powder at all after seven hours. The book that I produce is a summary statement of the tests of what we have done. It was made in Japan. It is written in Japanese. It shows what we have done and represents Japanese work. This one was published in March, 1924, there isn't any mistake, although it is very hard to see right away, because the Japanese had their own years.

(Counsel for plaintiffs thereupon offered in evidence the catalog or compilation of results referred to by the witness. Whereupon the following discussion took place:

MR. MORRIS: I am wondering whether the books should go in evidence.

THE COURT: Well, I don't believe it should, but I think there is no objection to putting the picture in evidence.

MR. MORRIS: That is what I was getting to, the book seems to me to be objectionable for two reasons, because, first, it is in Japanese, without translation, that is, I assume that it is Japanese, and the second is that it is probably not pertinent. I have no objection to the picture.

THE COURT: That is really all you want?

MR. WHITCOMB: That is all.

THE COURT: Nobody is going to translate that. It will be received for the purpose of the picture.

MR. MORRIS: That is, I have no objection to the picture, outside of my general objection.

THE COURT: Sure.

The compilation of results produced by the witness was accordingly received in evidence and marked Plaintiff's Exhibit 11.)

(The witness, resuming, testified):

We wanted to get air in there to get oxidation, but it isn't easy to control the temperature of lead and moving air, that is, the oxidating agent. There has to be a critical way to control it so that you get the best product and largest quantities. We made many experiments to ascertain some of these facts, as these books show. In that way, it was possible to see how much air had to put in, and what the best rate of speed was inside the mill, and what the air and what temperature was required. All of these facts are very important to produce the ideal material in the largest quantities. That is why we were working hard for years and years. We made about three hundred experiments, written in this book, which shows all the curves, specific gravity, production, and peripheral speed. I am referring to the first book, Plaintiffs' Exhibit 7, including a whole list of tabulations on several pages, each of which represents one of about two hundred experiments. The curve represents results at different speeds and specific gravities and production amount, showing that with ideal peripheral speed you get maximum production. Of course you have to control temperature

and what you have in the mill. These things show what was done so as to get the maximum production under all conditions.

With respect to peripheral speed, the results of our tests show that at low speed the lead would cascade, slide down, in a mass. At greater speed the contents rise to the upper part of the mill and fall down to the bottom part, that is, strikes the bottom of the drum so that there would be no powder producing effect or friction effect. You have to have just enough peripheral speed so that all pieces of lead have individual motions.

Mr. Morris: I beg your pardon, just a moment, I wonder if I can have the answer to that read?

(The answer was repeated by the reporter, as follows:

"A. Well, at low speed your lead would cascade, slide down, in a mass.")

By The Court:

Q. Does that mean the powder, you mean?
A. Contents.

Mr. Whitcomb: Means it would rumble down, just slides and does nothing.

The Court: All right, go ahead.

(The answer was continued by the reporter, as follows:

"A. At a greater speed the contents raises up to the upper part of the mill and falls down to the bottom part" . . . "strikes the bottom of

the drum, so that there would be no production, powder producing effect or friction effect.")

By The Court:

Q. Well, why wouldn't there, at a high speed?

A. Because inside the mass turns up with the mill, and it is at relative speed of drum and the inside mass changes, so instead of going with the mill it falls down, at a certain speed.

Q. Do you mean if you rotate at a high speed the centrifugal force would simply keep it plastered—

A. Yes.

Q. — against the sides of the drum?

A. I am not talking excessive high speed, that means everything, centrifugal force, it sticks.

Q. I see.

Mr. Whitcomb: Well, he is talking at a fairly high speed in which they would come up and just drop down in one lump in the middle.

The Witness: Yes.

By Mr. Whitcomb:

Q. It would fall in the free area in the middle of the drum and not hit other balls?

A. Excessive high speed?

Q. Not excessive, intermediate, fairly high speed.

A. Well, that is the reason the size of the mill and the revolutions is so important in this case.

By The Court:

Q. Well, I know, but this is what I want you to tell me, why don't the balls abrade and make powder at a high speed?

A. Not high speed, just enough speed.

Q. No, but why don't they do it, if you get it too high?

A. Too high—

Q. What happens if you get it too high?

A. Well, too high means some part of the product fall down and hit the bottom, and makes a noise, and gives a very—crushes the lead into pieces in some way.

Q. Well, but that is what you want.

A. Makes coarse grained powder if you have—

Q. But it will break up the lead?

A. Yes, break up the lead.

Q. But it will make it too coarse, is that the idea?

A. Yes, too coarse.

Q. It won't make powder, it will make chunks?

A. That is right, you might get free lead, pieces of lead.

By Mr. Whitcomb:

Q. Flakes, is that what you mean, flakes?

A. Yes.

The Court: I guess I understand that.

The Witness: As far as speed is concerned, you have to have proper speed so it agitates every individual piece, has individual motion.

The Court: It will shatter the lead rather than just abrade it.

Mr. Whitcomb: Yes.

The Witness: We tried very hard to see what the motion of the contents does, according to the speed of the mill, according to the peripheral speed, and found exactly what is the most

ideal speed for certain conditions. That was a very important subject.

By Mr. Whitcomb:

Q. What was the speed for your drum?

A. Well, ideal speed is, sixty inch mill, about forty, and you can start with twenty, twenty-four, twenty-five, most good speed is just about around forty, sixty inch mill, sixty diameter mill.

Q. Sixty inch, you mean?

A. Yes.

Q. Now, take the question of temperature, what about that? You say you went into everything.

A. This is also a very important thing. Ordinarily, when you cut and expose metallic lead, a gray film will appear in a few days. This is the lowest kind of oxide, which may be called lead suboxide. Under ordinary room temperature, this oxide does not change any more, according to the theory of equilibrium. But when the temperature changes and any oxidizing agent is present, an extraordinary change occurs, according to the temperature. So that, if you take the surface off and collect it you might find pure metallic lead powder and some of the so-called Pb_2O, suboxide.

By The Court:

Q. The point is this, that if you expose a lead surface to room temperature you will get a certain change?

A. Yes.

Q. But it won't increase, it will just stay at that point?

A. Yes.

Q. It will be a low oxide of lead, but if you do the same thing and raise the temperature—

A. Yes.

Q. — then you will get something else?

A. Yes.

Q. Now, what Judge Morris and I want to know is what that other thing you get is.

A. Well, get—get more amount of low—lowest stage of oxide.

Q. You get more amount of a lowest stage of oxide, is that right, and less of the metallic lead?

A. Yes.

There are two kinds of oxide. Up to 270 degrees Fahrenheit, you may not get yellow colored PbO. But above 200, somewhere around 270 degrees Fahrenheit, you will have yellow colored so-called litharge, PbO.

Q. So-called litharge PbO. Well, then, please go ahead and explain to the Court, when you accomplished your best experiments, say in the spring of 1919, or whenever it was, I understood you to say some time in 1919, what product did you get?

A. Well, we were just getting about the same product at the present time, very major portion of PbO, colored black; a small amount of Pb_2O and other oxides of lead, PbO, yellow color.

Q. What went on in the drum, do you know, in this, what happened in the drum?

A. You see, the principal reason, lead never goes into higher oxides directly from metallic lead, metallic lead to the higher oxides, that is, lead in the heated drum with the oxidation gas must pass the lower oxidation stage.

By Mr. Morris:

Q. Must what?

The Court: Must pass through a low oxidation stage.

By Mr. Whitcomb:

Q. Must first form Pb_2O?

A. Therefore, you can estimate the powder product you are making in the drum. The first thing is a black product which may be finely divided metallic lead, plus black colored PbO, or entire suboxide. This material is very hard to analyze, but I am sure that this original low stage of oxidation fills up the drum first. Then according to the control of temperature, you oxidize further any way you want, according to controlling temperature. That is the way Shimadzu makes all kinds of products.

Q. Did the lead suboxide formed pass on to, entirely to lead oxide, PbO?

A. No, according to the molecule construction, sometimes remains.

Q. Molecule construction?

A. Associates, or remains again suboxide, you can't tell this, very delicate, according to the temperature and amount of air, it is difficult to tell, but you know there is a certain mixture there, see, to make things balance, but, of course, you expose the material, you have more air, or moisture, but inside of a drum you have a certain low kind of oxidation.

Q. How was the metal formed, the metal powder?

A. You mean metallic powder, metallic lead powder, when it comes to ideal temperature and grinds finer, that is the finest product we ever had as far as metallic lead is concerned.

Q. How is it formed?

A. Well, you know, lead when heated up, certain temperature, becomes very brittle, and when you scrape the outside part, naturally you are scraping off some metallic parts, that is, finely divided metallic lead, just as suboxide or other lowest oxide. I can

prove this, because in the market, you have lead powder in the market, and you see that burns in the air, and except you are testing with a chemical reagent you don't tell, you can't tell what metallic lead or suboxide is.

Q. Well, does the suboxide break up?

A. Very easily.

Q. Into what?

A. Into the smallest grain you ever know, just little.

Q. What are they, grains of what?

A. We don't call grains; so amorphous, so fine, just like a liquid.

Q. Well, what are its chemical constituents when the suboxide breaks up?

A. Well, you have the pure metallic lead and the PbO.

Q. Then metallic lead is formed from the PbO, is that correct?

A. Exactly.

Q. And that is this very fine powder you are talking about?

A. Yes, the finest part.

Q. Could you get it that fine by the chipping action of the balls—

A. Yes.

Q. — themselves?

A. Yes.

Q. Wait a minute, you mean to say you can make it so fine just from a mechanical chipping?

A. Well, that is our essential, most delicate part of the thing we ever found.

Q. Well, I am asking you—

A. Yes.

Q. — what you got, the finest metallic lead in your substance, how did you get that?

A. Well, it is contro ling temperature and the way you supplied oxidation agent, air, for instance, and to get nice, harmonious action.

Q. Sure, but what does this harmonizing action—

A. To do that you have to know the amount to charge, temperature, air, and the speed of the mill, all kinds of things, you got to watch out, not incidentally, you couldn't do it.

Q. Well, is it possible to grind the balls themselves so that just grinding would give you that very fine? I thought when you first testified you said the early drums were so coarse.

A. Of course, that is true, because you haven't got enough temperature to deal with it.

THE COURT: Oh, well, I understand what he wants to say,—

MR. WHITCOMB: All right.

THE COURT: — and what you want him to say, and everything about it.

After we had a successful drum working, we next tried to make batteries from the new oxide. We made many experiments to produce batteries of more capacity and longer life. The Shimadzu companies, or the companies with which he was associated, had previously been making batteries. They bought the oxides. Now, with this new material, we tried to make a battery plate. We had difficulty, however, because this is entirely new material and we tried to find how good this material was for storage batteries.

Very fine powder is essential for the pasted type of batteries because coarse grained lead powder always contains a certain amount of metallic lead, which makes it unfit for the pasted type of battery.

By Mr. Whitcomb:

Q. Do you know why that is?

By The Court:

Q. What are the two plates made of, now?

Mr. Whitcomb: They eventually come to lead and lead oxide, Pb and PbO, after you get it worked up in a battery, but in both cases you start with this mixture.

The Court: Yes, I understand, but what do you get finally in the battery plates? There are two different kinds of paste you use aren't there?

Mr. Whitcomb: No, you use substantially the same plate, isn't that right, same material?

The Witness: You could use same material.

The Court: I thought the alternate plates were somewhat different.

Mr. Souther: The alternate plates, lead peroxide in the positive plate, and spongy lead, pure metallic lead, in the negative plate.

Mr. Whitcomb: We are going to have a witness on that.

The Court: I understand, I just wanted to get that straight. All right.

The Witness: But you can use same material for both positive and negative, only formation stage, the action changes into peroxide, and the other one, spongy lead.

The Court: All right.

By Mr. Whitcomb:

Q. When did you make the material that would be satisfactory? You said you ran this drum in March or April?

A. Well, during that time Mr. Shimadzu wanted very seriously to make excellent batteries, so we all engineers worked very hard, and finally we found this new material, the most ideal thing for storage batteries.

It is characteristic of this new material that it is so fine that it burns in the air, spontaneous oxidation takes place and there is violent action. When mixed with sulphuric acid or water and pasted into the grid of electric storage battery plates, the ordinary material, wet and dry, usually cracks, because of shrinkage of the material between the grid and the pasted parts, but with this material, lead hydrate forms and expands the volume so that it compensates for what shrinkage takes place. We found that there is no more buckling or cracking. That is disclosed in Shimadzu Patent No. 1584479. Lead hydroxide is the same as lead hydrate, which is referred to in that patent.

With respect to the drums, the particular mill that was made in April, 1919, was used for commercial production right along. Some of the setup in the plant is illustrated in my report Plaintiff's Exhibit No. 8, at page 24 (Fig. 28, Pl. Ex. 8a). That shows the worm-drive and how to feed the balls into the mill. That is the production mill. (The witness here referred to a book handed to him by counsel.) On the last page in the book is a picture of the machine as installed in the plant some time in June, 1919.

(Counsel for plaintiffs thereupon offered in evidence a picture of the installation in the book, which was received in evidence and marked Plaintiffs' Exhibit No. 12.)

In the particular installation illustrated in Plaintiffs' Exhibit No. 12, the air is forced into the mill through the feeding ~~mouth~~ on one side and discharged at the other end. Sometimes we have had a suction fan. The machine can be operated both ways, pressure system or suction system. In case the air is to be used for oxidizing in the drum, you have to change the way you send in the air current. You cannot operate the apparatus by suction only. You have to have the pressure fan through that so that air goes through the tube provided in the mill, and then you can have the suction fan. I am talking about a mill that provided tube nozzles. A mill without them can be used both ways.

(After recess, the direct-examination of the witness continued as follows):

In the last question, I referred to the use of a drum without the pipes but using the air. I stated it could be used both ways. The first time we just sent the air by means of using the fans. Now that we have the mill in operation, and used the fans with the tubes, we can also use the air without the tubes.

Q. Please explain in detail what—did you make any distinction on the grounds so far as the oxidation—take the oxidation first—is concerned?

A. Well, according to the amount of lead pieces in the mill, where the air is blown, if you haven't got no tubing, it is difficult to force out all powder formed in the mill.

Q. Do you force out some?

A. You can, but just about finest powders only.

Q. I tried to exclude the idea of forcing out, I asked the question as connected with the oxidation process going on. That does not make any difference in connection with the oxidation, is that the answer or not?

A. Well, I was just talking about what the air does.

By The Court:

Q. I wonder if this is what you mean, as far as the oxidation goes, can you do it just as well without the tubes as with it?

A. Yes. I am talking about the method of using the tube or not.

By Mr. Whitcomb:

Q. In my question prefer to forget about using the tubes. What actually happened when you did not use your tubes but used the air?

A. It is a little hard to blow out the product unless you add extraordinary amount of air.

Q. How about the oxidation, is that satisfactory?

A. Oxidation takes place just about the same.

Q. This morning you mentioned a temperature of two hundred and seventy degrees, but I understood that that was more or less when you began to get the oxidizing action. What would you say was the satisfactory temperature at which you were operating when you got your best results, early, we can just say, in the spring of 1919?

A. Well, making the most excellent production for unit, weight of unit, you must control the temperature at nearly 270 degrees. You produce the best amount of black powder at that temperature. If you want to oxidize more, you can maintain it longer,

and increase the temperature a little higher, as desired. The upper limit in the temperature is about 200 degrees Centigrade, as we estimate.

With respect to the effect of the air on the temperature, the horse-power put in is converted into heat, which causes the temperature to go up and results in a tremendous amount of oxidation. The air not only oxidizes and discharges the product, but cools the machines so that you can control the temperature. The air has the effect of cooling the top temperature. It is very important in this process.

I know that Shimadzu got patents in the United States, as far as these developments which I have detailed are concerned. Those are the patents in suit. I have read them. I have charts showing the type of apparatus that would be used in the first patent, No. 149. (The witness examined a chart.) This chart illustrates what the specifications describe. You have a revolving drum, and on one side you have feeding hoppers.

(Counsel for plaintiffs thereupon offered in evidence the chart referred to, which was received in evidence and marked Plaintiff's Exhibit No. 13.)

Then for providing the tubes, there are a number of holes, so that the air can blow through and blow out powder from one side of the cylinder opening, blow out the powder collected by means of dust catchers, by separation means. These notes I have written on this chart are exactly worded from the Patent No. 1584149. I have a similar chart for Patent No. 1584150.

THE COURT: What is the difference in the wording?

MR. WHITCOMB: You have accurately the language in the patent, he has followed similarly, generally everything generally similar, but presence of pipes in the second patent, he used pipes plural, he put on several pipes. Then there is a reference to a cooling apparatus used which is operated to cool and further control the temperature, so he illustrates the conventional form based on the wording of the specifications. Otherwise, there is very little difference.

(Counsel for plaintiffs thereupon offered in evidence chart on the 150 patent, which was received and marked Plaintiffs' Exhibit No. 14.)

I have a chart illustrating the 151 patent.

(Counsel for plaintiffs thereupon offered a chart in evidence, which was received in evidence and marked Plaintiffs' Exhibit No. 15.)

The foundation for the drawing in each of these charts I found in the wording of the specifications.

Shimadzu got patents in almost every foreign country which has patent laws. He got them in Germany. In connection with obtaining patents in Germany, we had some hard difficulties.

MR. MORRIS: If the Court please, it seems to me that that is not pertinent, and I object.

THE COURT: Well, it may not be, but I will take it subject to your objection under the equity rule.

THE WITNESS: We had some objections from certain parties in Germany to the granting of the principal patent, the Tudor Company. I have a copy of the patent proceedings. This is the translation of the government file from German

into English. I have the original German in my office in New York.

(Counsel for plaintiff thereupon offered in evidence the file of the German opposition proceedings, which was received in evidence and marked Plaintiffs' Exhibit No. 16.)

The Tudor Company of course is a very powerful company as far as the battery business is concerned in Europe, and they produced material witnesses and showed by practical operation and drawings how to make batteries, but we finally won the case. The higher court of the German Patent Office granted the patent to Shimadzu because they found it was a patentable application. The invention involved in that patent application was exactly the same application we had in the United States. The essential reason for the allowance of the patent to Shimadzu was that Shimadzu utilized the most important medium of oxidation, air, and what air does the German Tudor Company never can. I mean the cooling effect. You will find the cooling effect referred to in the German record, and what the air current can do with respect to the oxidation condition.

The operation of the mill provides that temperature that I defined this morning. I stated that the cooling effect was to keep the temperature the ideal way as desired. The lower limit was sixty degrees Centigrade. Up to sixty degrees Centigrade, you would get oxide of lead. The file wrapper I have introduced, showing the drawings of the Tudor mill operation, shows the construction, dimensions, working, everything.

With respect to Mr. Shimadzu's patent rights in the United States, negotiated with several companies

to dispose of such United States patent rights. When I was in Germany at the beginning of 1926, Shimadzu cabled me to come to New York and go down to Philadelphia to see Mr. Cary, Vice-President of Leeds and Northup Company, and I went to get in touch with him, to see what he knew about negotiations of oxide processes and dispensary. Mr. Cary went to Japan some time in 1925. I know, because he disposed of his sales agency in Japan. Mr. Cary went to Mr. Shimadzu's company's office and met Mr. Shimadzu, and while he was talking about his agency, Mr. Shimadzu told him about the lead oxide business. I was then in Germany. I met Mr. Cary in Philadelphia in June, 1926. Cary told me that he had a friend and he arranged to introduce to me those Exide people. The same afternoon I met the Exide people and explained this new invention in detail. Then started negotiations, and, of course, the Exide people knew most of the story through Mr. Cary. I understood that the Exide people were very much interested in our process. They went in the conference rooms and they gave me different answers. A few minutes later they came back and President Lloyd told me that we should provide terms for disposing of our rights in this process. He told me that personally. That was at the very first meeting. Meanwhile, I went down several times. Also we had meetings twice in Marks and Clerk's office in New York about this patent business. I went down to Philadelphia several times. The second time I went down I met Mr. Lloyd, Mr. Stoughton, I did not see Mr. Stoughton every time I went down—well, no others were there whose names I know. I met Mr. Smith some times. I went also to Marks and Clerk's office in New York Mr. Parker was there. Their business was the sit-

uation of American products. I have copies of the investigation of the patent standing.

THE COURT: Are they lawyers?

MR. WHITCOMB: International patent lawyers is what they are.

THE COURT: All right.

Nothing very serious happened at Marks and Clerk's office, except that we agreed to consider this matter further, that's all. Mr. Stoughton was there, Mr. Hall, Mr. Stoughton and myself, and Mr. Parker. This took place in August, 1926. The patents had already issued in May, 1926. We had two conferences at Marks and Clerk's in New York of that nature that I remember. The upshot was that they told me the matter should be further considered. That is the last answer I had. Meanwhile, we submitted contract papers. We haven't got them back yet. Of course, we didn't discuss the exact terms because I was awaiting instructions from Mr. Shimadzu at that time. I haven't got a copy of that paper at the present time. I gave the paper to President Lloyd.

MR. WHITCOMB: Counsel for plaintiffs would like to call upon counsel for defendant to produce the paper referred to by the witness.

THE COURT: That is the form of contract that was submitted.

MR. WHITCOMB: And he never got it back he said.

MR. MORRIS: I will look and see if we have it. I cannot answer at the moment.

We referred in the contract to a lump sum payment.

In connection with dealing with Exide, I had a legal power of attorney from Mr. Shimadzu's company. With respect to these conferences I have never heard anything since the last day, we met in Marks and Clerk's office. I had some important work to do and I went back to Japan. I went back about October of 1926. Early next year we had notice from the foreign office that United States patent was involved in interference with the application of Mr. Hall, the engineer of the Exide Company. (The witness here examined a paper.) The Hall application was dated in regard to the Hall patent cited in the answer to this suit. This patent is No. 1,888,823.

Q. What was the outcome of the interference?

MR. MORRIS: I wonder again if the witness should draw a conclusion by the outcome of the interference? That should be shown by documentary evidence if it is pertinent at all.

MR. WHITCOMB: Question withdrawn.

THE COURT: What was the result of it? I am interested in it, can somebody tell me?

MR. WHITCOMB: Priority was awarded to Shimadzu on two grounds, one of the opening—

THE COURT: Never mind about that, what I want to know was Shimadzu—

MR. WHITCOMB: He was the winner, in the vernacular.

MR. MORRIS: Well, couldn't—I am sorry.

MR. WHITCOMB: We will get into that later. I would like to introduce the—

THE COURT: That was in the case before, but I had forgotten it.

MR. MORRIS: One of the grounds was that Hall did not have suboxide, nor—

MR. WHITCOMB: And the other was the dates and invention. Remember the arguments at the hearing?

THE COURT: Yes.

MR. MORRIS: Hall had priority to the claim sought, but he had no dates for the substance which they contended he did not have.

THE COURT: Yes.

MR. WHITCOMB: Your Honor, could we have a minute's recess? We think we have got a copy of the letter they are talking about.

THE COURT: How much time do you want?

MR. WHITCOMB: Five minutes.

(A five-minute recess was taken.)

Counsel for plaintiffs thereupon offered in evidence the file wrapper of U. S. Patent No. 1,675,345, which was received in evidence and marked "Plaintiffs' Exhibit 17". The file wrapper of patent No. 1,888,823 was also offered and received in evidence and marked "Plaintiffs' Exhibit 18".

(The witness resuming testified):

I was keeping in touch with Mr. Cary. As soon as I arrived in this country I had a letter from Mr. Cary describing what was going on. He gave me a copy of a letter which I can produce. This is the one (the witness here examined a letter). It shows Mr. Cary's letter from Mr. Smith. This was writ-

ten by Mr. E. W. Smith to Mr Cary, vice-president of the Leeds and Northup Company. It is dated May 13, 1926. Mr. Cary showed me that and gave me a copy. This is the copy he gave me.

(Counsel for plaintiffs thereupon offered in evidence the letter produced by the witness which is dated May 13, 1926, written by Mr. E. W. Smith, factory engineer, to Mr. Cary; which was received in evidence and marked "Plaintiffs' Exhibit 19".)

He was referring, by the United States Patent Office, to the fact that they did not take any license under these patents because these parties were involved in the interference against our petition. That is the last I heard of it.

In 1928 the U. S. L. Battery Corporation took licenses in the United States under these patents. There was a license. It has been in force since 1928. Payments have been made to the extent of 25% of the profits, that means pretty near forty thousand dollars a year. Twenty-five per cent. of the profits is forty thousand dollars a year.

Licenses have been taken out in England and France under a number of British and also many French patents relating to making the product for material for storage batteries and also oxides. The same kind of patent broadly, which I was talking about this morning. We got patents all over the world at about the same time. We got a series of patents, several of them in this country and several of them corresponding to each other. We got them in the other countries.

References to the issuance of the Japanese patents were published in "Chemical Abstract", issued

in this country. I have seen the issue of May 10, 1924 which shows all details of Shimadzu's Japanese product, translated into English. Five or six patents were referred to in the same issue of May 10, 1924 of "Chemical Abstract" at page 734.

I know that a notice of infringement was sent to the defendant in this case with respect to these patents. Notice was sent claiming that they had infringed on these patents. That was handled by Judge Newton. He consulted me and he said it was the proper thing to do. I don't know exactly when he did send it. I have a copy but not here. I know it was done.

Cross-examination.

By Mr. Morris:

With respect to the balls appearing on page 70 of "Plaintiffs' Exhibit 11", lead balls were rotated seven hours without giving one pound of powder. We got no powder. Actually, we don't use balls, we use lead pieces. We have not used lead balls for several years. We got no powder. But the pieces got rounded like that. We were not operating with air. Carbon dioxide passed through at that time. Those balls stayed at just about room temperature. Our R. P. M. was about twenty to twenty-five. The drum was sixty inches. It operated at a peripheral speed of about 470 feet and remained at room temperature. There was heat friction but it did not increase the temperature by much. Our load was not more than one thousand pounds or so. We had a thermometer in that mill around that time. There was a little variation in temperature but we were using carbon dioxide. There was no oxidation heat just a little heat from friction, but the balls were so

brittle that there was no friction. Consequently, the power consumption was very small. There was no heating going on. Our other mills operate under different conditions. You do not necessarily have to have oxygen present in a free state in order to get heat from friction. If you have some oxidizing gas present you may have more heat from oxidation. You must remember that the material passes through the carbon dioxide not over the air.. You pump the carbon dioxide into the drum. We ourselves simply introduce the carbon dioxide into the drum. That prevented any heat from friction except for a little, because the metallic surfaces are very smooth.

I am an engineer. Oxygen is, of course, essential to the production of heat from friction, but you have to have enough friction. Whether a rotation of twenty-five revolutions of a drum having a diameter of five feet, a load of one thousand pounds and chunks of lead will produce no heat from friction, depends upon the nature of the experiment. If it is passing through carbon dioxide, it is operating under entirely different conditions and circumstances. According to our experiments, passing through carbon dioxide, there was no heat raised. The temperature was not increased to any extent. We had thermometers present. We kept a record of that experiment. It is in the Japanese records. It is in the Japanese exhibit. Here it is (indicating page 69 of the book containing plaintiffs' Exhibits 11 and 12). I am sorry I cannot give you the thermometer readings. These things were done 15 years ago and I cannot remember The things I am pointing at tell of sending in the carbon dioxide into the mill. I am reading here (indicating). "Table 49, test No. 96. Time is 9:14, 4:14: seven hours. Revolutions 38, and we retain that

Lead pieces, 750 kilograms." I don't know exactly how much that would amount to translated into pounds. "Temperature inside of room, sixty-eight, Centigrade; inside the drum, seven to thirteen centigrade; out of the drum, seven to thirty-one. That shows the temperature don't go up." The highest temperature we found in the drum was thirty-one degrees Centigrade. That is something like eighty-eight degrees F. This operation was conducted some time in the winter in the year 1919. The highest temperature I read was sixty-eight degrees F. We had two different temperatures. The highest Centigrade is thirty-one. That is on this page (indicating). The test there (indicating) is the rotation of the lead balls. We had 750 kilograms. This thirty-two degrees is just the room temperature. Six to eight is the room temperature. This thirty-two is the temperature of the carbon dioxide gas coming out. The left temperature was thirty-two degrees Centigrade. This is the temperature outside of the drum. The thermometer was attached somewhere outside of the drum, just outside of the contents.

We did not get any powder because there was no oxidation. If you have no oxidation you cannot get any powder. Unless you have oxidation you cannot get any powder.

There is not exact correspondence between the United States and Japanese patents. I would not say that they were exactly corresponding because the Japanese is entirely different from the English. You cannot get exactly the same, that is, a word by word translation. I do not know whether there are Japanese patents for the invention described in United States patent '149 in suit. I don't know anything about those patents anywhere. I cannot say exactly what are the patents in Canada that corre-

spond to the patents in America. We have just about the same patent, the same application. I know that there are patents in these foreign countries, but I don't know exactly the number and when it was gotten, and things like that. I knew that they were corresponding patents because the maker of the invention is the same and the improvements are about the same. That applies likewise of course to the patents in Japan.

Plaintiffs' Exhibit 13 was made up a couple of weeks ago, I think, by the assistant to Mr. Whitcomb. That applies also to Plaintiffs' Exhibits 14 and 15.

By Mr. Morris:

"Q. Now, then, will you tell me what year the experiment was made with respect to the lead balls that we were talking about before the recess, in here?

A. You mean starting of the experiment?

Q. No.

By The Court:

Q. No, no, what year did you make that experiment that you got that picture from in exhibit—

Mr. Morris: Exhibit 11.

A. Some part of—winter of 1919.

By Mr. Morris:

Q. The winter of 1919, you mean perhaps November, December, January, February, what?

A. Must be winter, because room temperature is 7 degrees Centigrade.

Q. 7 degrees Centigrade?

A. Yes.

Q. And that is only 44, 45 F., isn't it, so that

might have been November, December, 1919, or might have been January, February or March of 1920?

A. Exact date, it isn't said in this book, it is so long ago I can't tell you exactly.

Q. Was the winter of 1919 any colder than the winter of 1920?

A. I can't tell now.

Q. So you are judging the date solely by the temperature, are you?

A. No, see, the room temperature, about 7 degrees Centigrade, in some way.

Q. Yes, but it would be approximately that same temperature in the winter of 1920 or 1921, wouldn't it, also 1905, or 1906.

THE COURT:

THE COURT: No, but he is talking about something different, he is talking about the month.

By THE COURT:

Q. Now, how do you know that the year was 1919?

A. I don't think we conducted, did this test—

Q. Does the book give the date? Does the book give the date?

A. This is a summary of the whole thing, written in 1924.

Q. I see.

A. So these tests were done way before.

Q. Well, all right, then, then the only thing you can tell from the temperature was, it was the winter. How can you tell what year it was? How do you know now what year it was? You say it was 1919; how do you know that?

A. Well, after we—

Q. Now, wait, turn over this way so I can hear.

A. This present operating condition, we didn't

test no more, this was before 1920 or 1921, and where we found what air does was the end of 1919, to '92 or '91—1921, so must be along that period.

Q. In other words, this experiment was finished before you started with the air, is that right?

A. No, after we started air and everything else, before we established the normal operations of the mill.

THE COURT: Well, all right.

By MR. MORRIS:

Q. And your air was in 1920 and 1921, and this was before the air?

A. No, no, after the air, see what, to find out what the air does.

Q. But I understood you a moment ago to say that you stopped experimenting after you found out what the air did, was that right?

A. Well, I don't get you exactly, what you mean.

Q. Are there any dates in this book, Exhibits 11 and 12, to show anything about the year in which it was conducted?

A. No, this is a summary—

Q. Well, the answer—

A. — of the tests.

Q. — is "no", then, is it?

A. Tests done up to March, 1924.

Q. Is there anything in this book to tell you in what year that experiment—

A. You know,—

Q. Do you know how to say "no" or "yes"?

A. No, the book don't tell you the exact date of the experiment.

Q. Is there anything in that book to tell you whether that experiment was in 1919?

A. Well, all the experiments done since 1918, don't classify, the experiments done, certain date.

By THE COURT:

Q. No, but now, then, Mr. Ishimura, he is asking you a plain question, you ought to be able to answer that, is there anything printed in that book which shows that that experiment was done in 1919?

A. I think there is.

Q. Well, now, will you show it to us? What is there that shows that that experiment was done in 1919? That is what he wants to get.

A. Well, exactly there is no description, but my recollection.

By MR. MORRIS:

Q. There is no description in the book, but it is your recollection?

A. Yes.

THE COURT: That is all.

By MR. MORRIS:

Q. Then there is nothing in the book to tell you that that experiment was conducted in 1919?

A. But I am not so sure.

I did not make the drawing, Plaintiffs' Exhibit 13, myself. I have no idea who made that or how it was made. It was done by just ordinary engineers who drew it from specifications.

In a drum rotating fifteen, twenty-five revolutions a minute, the drum being sixty inches in diameter, you do not have a vacuum condition, you have oxidation all the time. This cooling device for heated air to go off is necessary for the reason that when you have sufficient air pass through the mill naturally oxidation takes place. That means a tremendous amount of heat, oxidation heat, develops. If you don't send in enough air to cool down you naturally

have to have some means to cool the mill so as to keep down your temperature normal. In this drawing number '150 patent, we are sending through about five hundred to seven hundred and fifty cubic feet of air per minute. The patent didn't describe that. According to the patent, enough air is sent through the drum to impinge upon the contents in the drum. I does not seem as though it does impinge in '149. The air is just passing through. According to the pressure, of course, it might impinge. I am not sure whether it would impinge at a pressure of two pounds and a half per square inch. The pressure provided for in '150 patent is just about two pounds, two pounds and a half. I do not find that in the patent. I know that no value is specified in '150. I don't think that there is anything about air volume in patent '150, but the way it describes certain pressure indicates a certain pressure, where it is stated that the air impinges. It doesn't say anything about pressure. '149 patent does speak about a pressure of two and a half pounds. You cannot convert that into volume. You cannot tell about the volume but in each there is enough volume of air to blow the dust out. As illustrated in Plaintiffs' Exhibit 14, the air would be sufficient, introduced into the drum, to blow the dust out immediately after formation. It is not necessary that the dust should be blown out immediately. It can be taken out as desired. With respect to patent '150, you can blow out the product right away or you can let it stay a little while.

Regarding the difference in the product disclosed in '150 from the product described in '149, '149 had a certain amount of oxide, that is more black color oxide, whereas the product of the other patent could be regulated. '149 makes a product containing mostly Pb and PbO. There are two kinds of PbO, black

color PbO. In '150 according to the way you control the mill, you get more oxidized product, but you pass the same stage and you have different temperature which is a very essential thing. The two patents differ. As to the comparison between patents '150 and '020, I should say you can make exactly the same product or different products. You can make the same product or a different product. I am talking about the final product. I am talking about the product that I referred to this morning as lead suboxide, with respect to all of the patents. In all of these processes you have got to pass through this suboxide stage. So therefore you get different products depending upon the way you control the machine. According to what is taken in the drum, you will get exactly the same product in '149 and '150. According to the blast of air, you can keep it or you can blow it out right away in patent '020.

I testified in the interference at Washington. I recall being asked on question 42 of my examination in interference No. 54,798 the question: "Does any powder accumulate in the Shimadzu Machine?" and that I answered "No". In that case only five or six counts, claims, about lead suboxide were cited. In order to make suboxide of lead the material has to be blown out immediately under lower temperature. Even when you make things at a higher temperature, you have always got to pass through this stage of oxidation. Whatever oxide you get, it starts with Pb_2O and then goes on to the higher or further oxides. Pb_2O is the most interesting. "Now our experts will testify this, see. I don't know much about the chemical side of the thing".

As I understand this patent, the drawing of Plaintiffs' Exhibits 13, 14 and 15 is a proper representation. That is as I understand the patent and

the drawing. This drawing, drawn by an ordinary engineer, deals with the specifications and not with the actual machines. I know the actual machines, also I can read specifications, and the way I see this drawing it is a proper representation of what is described in the specification.

I came to America in 1926 some time in the early part of June. Patents '149 and '150 had just issued. Those patents had issued on May 11, 1926. I knew this patent was going to be issued because I was here in 1925, and concerned with the Patent Examiner and the Patent Office. I was here at the end of the year. In June 1925, I went to Germany and according to Mr. Shimadzu's instructions came back again in June 1926. I don't know exactly the date in June 1926 I arrived. It was the early part. I first saw the president of this defendant, The Electric Storage Battery Company, June 29, 1926. I was down to meet Mr. Lloyd. Apart from what was disclosed by those patents, I gave the officers of Electric Storage Battery Company, for one thing, information as to the production rate per unit of hour or unit of weight. From an economical standpoint that was very important. Of course, the manufacturing cost per pound of product is a very important thing as compared with what was bought during these days from other outside companies. That naturally interested your people I think. Otherwise, you would never start. Our patents in suit disclosed exactly how to do this. The patents didn't disclose the amount of air or temperature and how much you get per hour. Apparently your people did not know the exact numbers of the patent and specifications until the time I met your people. The patents had issued. But there was a question as to whether your people, your

company officers, noticed that such things existed. So that all my testimony about the conferences in Philadelphia and New York means that I brought these patents to the attention of the Electric Storage Battery Company. At the conference with Mr. Lloyd, Mr. Hall and Mr. Stoughton in Philadelphia and New York, of course, I cited all the patents that we had obtained in this country. I made a copy of the Japanese application and patent numbers for Mr. Lloyd's reference. I also had a very important Japanese patent translated into English and gave a copy to your company for reference. There were about ten of them, most important Japanese patents, of which I gave you a translation at that time. All of these Japanese patents had issued. They did not exactly correspond to the American patents. They differed in many, many parts, as for example, the Japanese patents had no perforation while the American patent had perforations, things like that. It was a question of whether the walls of the rotating mill were perforated or not, or put the air through or not. Because of such differences the patents did not exactly correspond to each other. There were such minor differences as are disclosed in the specifications of the patent in suit, namely, that you could use the rotating drum that is perforated, or you could use one that was not perforated, without the air or with the air. "Without air" means without any equipment to supply air artificially.

The witness here referred to Plaintiffs' Exhibit 9. We weren't using any fan or anything else to send air in. I did not show the drawing of Plaintiffs' Exhibit 9 to Mr. Lloyd.

We began to get a product with our process at a temperature somewhere below about two hundred degrees Centigrade. That is three hundred and ninety-

two degrees F. The product is different at three hundred and ninety-two degrees F. as compared with the room temperature, because oxidation takes place in a different way and at a different temperature. Of course you don't get the same product at three hundred and ninety-two degrees F. that you would at room temperature. It will give you a change in product. You would get some kind of product at one hundred degrees Centigrade, which would be two hundred and twelve degrees F. Other conditions remaining the same, when you operate at one hundred and twelve degrees F. you get a different product from that which you would get operating at two hundred and twelve degrees F. At one hundred and twelve degrees F. the product would not be very different from that at one hundred and twenty-five degrees F., as the temperature range is so close. There will be some little difference in the product between one hundred and twenty-five degrees F. and one hundred and fifty degrees F. I don't know exactly how much. The difference would be a difference in oxidation. There would be a slight change in the difference between one hundred and twenty-five degrees F. and one hundred and fifty degrees F. and that which you would get between one hundred and fifty degrees F. and one hundred and seventy-five degrees F. As the temperature rises, products change accordingly. If you operate at room temperature your product would contain mostly metallic lead.

I didn't hear Mr. Stoughton say when I was in New York at Clerk and Marks that our patents were invalid by reason of our Japanese patents. He never said a thing at all. The only thing he said was "We will have to look over again". Then give me an answer. I went down there many times for the purpose of endeavoring to get the Electric Storage Battery

Company to take a license under our patents. That was the mutual interest. Your people were so interested in this process. Therefore, we might be able to let you have prices or patent right. They never sent for me, but Mr. Cary told me that his people were very much interested. Mr. Cary told me that when I met him the 29th of June 1928 in his office in Philadelphia I had gone to see him in Philadelphia. That same day Mr. Cary took me to the head office of the Exide Company. The defendant never sent for me exactly.

I spoke of the German patent application. It was opposed by the Tudor Company, but the Tudor Company didn't use its own name. A witness represented the Tudor Company. I got the name of the engineers representing the Tudor Company. The Tudor Company is not one of our licensees. It never has been. No license was ever granted by Mr. Shimadzu, the owner of these patents, to any of the people who were opposing him in Germany to my knowledge.

Re-direct-examination.

By Mr. Whitcomb:

In connection with all experiments with CO_2 gas, of course, some heat of friction was developed, but such an amount of CO_2 gas passing through naturally cools down, and the friction of the materials on each other would not give you much friction heat. The room temperature was seven degrees Centigrade and the whole mill wouldn't go up to more than thirty-one or thirty-two degrees Centigrade. When you have air you have oxygen, and you have little friction, the air starts oxidation, oxidation heat, which according to my memory is just equivalent to what

the power supplies to the machine. A tremendous amount of oxidation heat is going on.

Q. Then the use of the air contrasted with the use of the drum without air is a decided difference in your opinion, is that right?

A. Therefore there is a difference between them.

When I was talking about the difference between the United States patents and the Japanese patents, I considered that a major difference, of course. It is a major difference when a Japanese patent failed to show the use of the air. When I was testifying about the use of different temperatures with respect to the use of the apparatus of the '150 patent, I was referring to the different amounts of the mixtures of the materials, metallic lead, Pb, Pb_2O and PbO. What I mean is the proportion of these three change. I do not mean any substantial differences other than proportions. The information I was trying to give to Exide above what was shown in the patent concerned the manufacturing cost per unit weight, which is very important. I think I gave them specific figures as to how much it would cost per hundred pounds of oxide by Shimadzu process.

Re-cross-examination.

By Mr. Morris:

With respect to my last answer that it was only a change in proportions and not a change in the character of the product of the operation, I think the proportion of the mixture changes but not the character. I did say, page 19 of our interference, with Mr. Hall, No. 54,798, in answer to question 92, referring to Mr. Hall's process, which consisted in part of the use of a Hardinge Mill and feeding the balls

in one end of the Mill and the dust passing out at the other with air passing through the Mill in one hollow trunnion and out the other—

"In this process no matter how much air is supplied through the mill, it will not give a motion of carrying the forming powder and its medium. In such operation powder forming in the mill filling up the space between the balls, remains longer until it is mechanically discharged or spit out from the end of the mill. Therefore at such a high temperature as 300 degrees Fahrenheit will convert the producing powder into a higher state of oxide. This is the practical reason why Hall's product shows a yellowish olive green color."

Q. Did you say at page 18, in answer to question 89:

"The principal difference between the two is that in the Shimadzu process we take the powder as quickly as possible as it formed, whereas in Hall's mill the powder once formed stays for a very long period under excessive heat generated in that mill; that is, the operating temperature is too high to produce suboxide. Whereas the Shimadzu mill separates the forming powder very quickly and collects it at the place under a comparatively lower temperature so that the powder has no chance to transform into a higher state of oxide."

And then the next question, which was 90, this:

"Would that apply to all of the Shimadzu Mills—different forms of them?"

And was your answer to that:

"Yes."

Have I quoted you correctly?

THE WITNESS: What you read is correct, as I remember. I have nothing to say yet about this explanation. If you ask me why I said so there is reasons, of course. That interference case involved only four or five claims, mostly about suboxide, how to make lower state of oxidized product. In that application, if your temperature is too high, and you keep the material in the drum so high, you can't get the major portion of suboxide, or so-called lower stage of oxide. In order to do that you must remove the powder quickly as formed and the temperature should be a good deal lower. That is why the difference. The processes are different. Coming to the general operation of the mill, you could produce both processes exactly the same. What is taken in the drum is exactly the same thing, and you will get the same proportion of the product. Even if you operate at high temperature like Mr. Hall's machine, you will have exactly the same kind of oxide present in there. While at lower temperature the proportion changes but you have always three kinds of oxides, I mean materials there.

Q. At page 15, question 64 was this:

"Why was the powder in the Hall mill yellowish olive green, while that from the Shimadzu mill was black oxide?"

and was your answer not this:

"Because Hall's product must be higher oxide—higher than suboxide. I will state it this way: Because Hall's product is in the state of oxide,

whereas the product from the Shimadzu process is mainly composed of suboxide."

Is that right, have I quoted you correctly?

This description is right, but it referred to just what we had in the claims in the interference case, nothing else, it didn't cover the whole patent claims.

We tried a Hardinge Mill. We tried to operate the Hardinge Mill at Depew just duplicate strictly according to Mr. Hall's specifications. We tried for ninety-four hours continuously and found all about it. I was there every day and I knew exactly what was going on. When the Mill was operated we got exactly the same result that Mr. Hall had specified and there wasn't any amount of suboxide in the product. That was what we wanted to prove in the interference case. We couldn't prove it. We wanted to get some suboxide so Mr. Hall could claim the interference case. He apparently thought he could make the same product as Shimadzu according to his specifications. That is why he found himself in an interference case. We wished to see how Hall's machine operated under his specifications and we got exactly the same thing Mr. Hall said in his specifications.

Q. And was the question page 129, number 36 as follows:

"Now can you explain in your own way why you can not get lead suboxide with the Hall apparatus, and do get it with the Shimadzu apparatus?"

and was your answer this:

"In Hall's apparatus he charges so much lead balls in the drum, and the drum itself revolving at comparatively very slow speed, and a very

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small quantity of air passing through the mill, and the mill itself kept at such a high temperature as 300 degrees Fahrenheit, and the way operated the powder produced in the drum stays a very long time in the mill; therefore the finely divided powder will change into higher oxide. Suboxide of lead can not be produced at such a high temperature and under such a condition as described above. That is, the powder that was formed stayed in the drum a very long time and evidently was transformed into high oxide. That is why the product of Hall's process shows a yellowish olive gray color, quite different entirely from suboxide of lead. Furthermore, not only the quantity of air passing through the mill, the way of feeding the air into the mill, not used as a medium of carrying the producing powder. It is only partly utilized as an oxidizing agent. That is the reason why the powder stays so long in the drum under such a high temperature— it is practically impossible to produce such a highly reactive powder as lead suboxide under such a high temperature."

Have I quoted you correctly?
A. Yes, according to the temperature.

Re-direct-examination.

By Mr. Whitcomb:

I mean by "according to the temperature" that Hall's machine is operating at a higher temperature, produces a higher grade of oxide product. For that reason he can't get the suboxide stage of product as a final product. I have seen Dr. Wilson's report on the inspection of Exide's plant for this case. Hall's

patent disclosure did not disclose the same thing. He grinds metallic lead into fine powder first, then oxidizes under controlled temperature. I think that is what that means. Mr. Hall employed a grinding mill like the Hardinge type. I know almost exactly how the Exide machine at present operates. It is quite different from the process which we tested in Depew, following Hall's specification.

Re-cross-examination.

By Mr. Morris:

I don't mean that the mill operated by Electric Storage Battery is different from the operation disclosed in the Hall patent in the way described in the patent. But the machine itself, taking the Shimadzu and Hall's, is exactly the same. Everything takes place exactly the same. There isn't any difference except in the shape of the drum and things that don't count. You can take the temperature, air, amount charged, anything, you can change according to your desire. From my experience of fifteen years, the construction of the machine, the way it operates, is exactly the same. Mr. Hall operates at a temperature of about three hundred and forty degrees F. In his testimony in the interference case he said three hundred, so we tested at three hundred. His product is perhaps a little different from the yellow oxide. At three hundred and thirty, three hundred and forty degrees F. there is a little difference, of course, Because of the temperature differences. I should think that the product that Electric Storage Battery is making now is a little different from the product that Hall was making at the time of the interference. There is a higher degree of oxidation now, when it is operated at three hundred and forty or three hun-

dred and forty-five degrees F. There is a greater proportion of oxidized lead. It may contain a small amount of suboxide and metallic lead besides. His product, the yellow, or olive green, might have contained some of what you call suboxide. It may have contained that when I was in the interference with him. I wasn't sure at that time. I think the oxidation would be higher at three hundred and forty or three hundred and forty-five degrees than at three hundred degrees F. The product that we got at Depew in connection with the operation during the interference with Hall may have contained a small portion of lead suboxide. It may still have some proportion. But less now with the three hundred and forty to three hundred and forty-five temperature than he would have operating at three hundred.

Re-direct-examination.

By Mr. Whitcomb:

No X-ray examinations were made in 1919. I have seen some of the recent examinations. We do not have the same method of tests now that we had in 1919. Now you have the X-ray method. I am sure that there was a small portion of lead suboxide and metallic lead in the mill during the interference. I think Hall's apparatus also had a lot of suboxide during the interference. I think they had ninety per cent of suboxide in the mill in Hall's plant as made during the interference for some few seconds. But he had it, at least.

Re-cross-examination.

By Mr. Morris:

I was talking at that time about your product.

Now I am talking of what is taking place inside the mill, a different thing entirely. I was dealing then with what you got outside the mill. I am dealing now with what he gets inside the mill, before the final product goes out. My theory then was that Hall could not made "suboxide", according to his specifications. That was in the interference case. It was my opinion then that he had suboxide, as I designated, inside the mill. At the time of the interference in 1930, we made some tests and tried to follow Hall's specifiactions. We didn't get any lead suboxide as a final product. According to his specifications you wouldn't get lead suboxide. As I understand it the lead never directly oxidized into litharge from metallic lead. Metallic lead never oxidized directly into higher oxide. I didn't have any idea as to whether the final product he got out of the mill had lead suboxide in it. I did think that whatever he got went through the stage when there was lead suboxide in it.

Counsel for plaintiffs here offered in evidence the Report of Inspection of the Gray Oxide Plant of The Electric Storage Battery Company, consisting of the report, the supplemental report and the drawing attached thereto, made by the Court's expert, Dr. Wilson, which was received in evidence and marked "Plaintiffs' Exhibit 20".

Re-cross-examination.

By Mr. Morris:

Q. In the Interference proceedings in Washington, number 54,798, I read from the printed copy of the record, question 79, at page 135, or page 17 of your testimony, this question:

"Q. Did the mill have holes in it?

"A. We have two kinds of mills: one having holes on the surface of the cylinder, and others only provided with the bent pipes in the mill so that air can blow through the pipes on the surface of the contents. The principle of these two types is exactly the same. The main point is to blow out the forming powder as quickly as possible so as to let escape the powder as it formed."

You so testified?

A. Yes.

Q. Turning to page 147, question 112:

"Q. How about the powder that you got from the reproduction of the Hall machine—how did you find out that was not lead suboxide?

"A. The first, its color, and when I observed through a miscroscope it contained a large amount of colored oxide, and it did not spontaneously oxidize even when a lighter match was applied to it. In comparing with Shimadzu's product I think it does not contain any quantity of suboxide. That is, the operation, the process is entirely unfit to produce such a highly reactive powder as suboxide. I think the result of our chemical analysis of the product we obtain in the Depew experiment will show more closely the result of above."

You so testified?

A. Yes.

Q. Page 512 in the other Interference, namely, number 56,224, page 54 of the last Interference, of your testimony,—

MR. SCHAFFER: What page of the record?

MR. MORRIS: 512.

MR. SCHAFFER: Thank you.

By MR. MORRIS:

Q. RDQ281:

"Mr. Ishimura, in the Hall application 702,889, it is stated at the bottom of Page 3 and at the top of Page 4:

> 'From the foregoing description it would be apparent that the pieces or balls of metallic lead are reduced to powder by mutual attrition, and that powder is oxidized under controlled temperature, and available oxygen conditions.'

If you treat those balls by oxidizing the surface, then grinding off the oxide that you have formed on the surface and oxidizing it as stated in that passage that I have read, could you possibly produce some oxide or lead?"

"A. It seems to me that there must be something missing there: that is, the pieces of metallic lead ground into powder form, then to oxidize such powder into the higher oxide, are difficult things to do: that is, unless you oxidize first the surface of the lead, it is impossible to make metallic lead powder into the powder lead form. That is, you have to oxidize first: then, such oxide, being comparatively brittle, compared to the metallic lead, is easier to scrape off into the powder form. Therefore, the description specified in that Hall Patent Application seems to me illogical, in case of converting finely divided metallic lead powder into sub-oxide; it seems to me also difficult to catch such a transformation point from metallic lead to sub-oxide.

"DQ282. In the Shimadzu Process, is the powder oxidized after it is ground off?

"A. No, it is not. The metallic surface is first oxidized, and the forming oxide is abraded off in a successive operation."

Q. You did so testify?
A. Yes.

Re-direct-examination.

By Mr. Whitcomb:

Q. Wait a minute, Mr. Ishimura, then on page 165 of the record that appeared before the United States Court of Customs and Patent Appeals, in Washington, did you not testify:

"You are quite sure you can take a Hardinge machine and make lead suboxide, can you?
"I cannot tell you how to modify it, but I know that a great change ought to be made if you want to make a suboxide on the Hardinge type mill. But I know it is impossible to make suboxide according to the Hall specification."

A. Right.

The Hall statement is directed to the claims involved in interference, not covering all claims of the Shimadzu patent, therefore, my statement should be judged with reference only to these five or six claims involved in the interference. I mean that I was testifying in the interference as to the claims of the Hall patent, not as to whatever actual process was going on in the defendant's mill. At the time of the interference nobody representing our side had been in the defendant's mill. We did not know what the actual operation was. I was testifying with respect to a

theoretical mill built according to the Hall specification, and a test made by us with such a mill. What we did was exactly according to the Hall specifications. Some change would have to be made to make them operate like the Shimadzu process, as, for example, by increasing the amount of air, increasing or decreasing the charge, increasing the speed and also controlling the temperature in certain ways. I don't think you would have to add any apparatus to the machine or change the shape of the drum which doesn't count anyway. At the time of the interference neither I nor anybody representing our side had any of Hall's product as made by Hall. In the first interference neither of the counsel for either side asked me what went on in the transformation in the mill itself.

GEORGE L. CLARK, an expert witness called on behalf of plaintiffs, having been first duly sworn testified as follows:

Direct-examination.

By MR. WHITCOMB:

I am Dr. Clark, from the University of Illinois. I have been at the University of Illinois eight years, now beginning my ninth year. I am a graduate of Depauw University, with a degree of Bachelor of Arts; of the University of Chicago, with degrees of Master of Science and Doctor of Philosophy; professor of chemistry following the war at Vanderbilt University; three years research fellow at Harvard University in physics; three years assistant professor of applied chemical research at the Massachusetts In-

stitute of Technology; and since 1927, professor of chemistry at the University of Illinois. I have written books on chemical and technical subjects. They are "Applied Ex-Rays", which has appeared in two editions, 1926, and a second edition in 1932, published by McGraw-Hill Book Company of New York.

Q. What have you to say about the X-ray use and methods of examining materials, briefly and broadly, first?

A. The ordinary use of X-rays familiar to the layman, of course, is that in medicine, where, of course, the familiar broken bones and teeth, and so forth, may be examined by radiograph, by radiography, the science of radiography, in which we depend upon the differential absorbing power of these invisible rays.

However, since 1912 it has been definitely known and established that X-rays, being similar to ordinary light in every respect except wave length, has certain fundamental physical, optical properties, such as polarization, reflection, refraction, diffraction. It was not known until 1912 what could be used for purposes of diffracting X-rays in the ordinary optical sense, but in that year von Laue, in Germany, discovered that ordinary crystalline substances, by virtue of the fact that they are constructed from atoms and molecules in regular arrangement, on equidistant parallel planes serve admirably as three-dimensional diffraction gratings for X-rays. Consequently, we may depend upon this phenomenon of diffraction not only to measure the spectrum of X-rays, the wave lengths contained in an X-ray beam, but we may reserve the process and study the ultimate structure, the ultimate arrangement in space, the ultimate architectural plan of solid substances, particularly solid substances which we know as crystalline.

THE COURT: Yes.

Q. It might be a good idea if you would tell me what diffraction is. I don't know what it means.

A. Well, diffraction is the optical property of curling around an obstacle. For example, if you will remember from your days in physics, we rule lines very close together on glass or metal and allow a sunbeam or ordinary ray of white light to fall upon that grating. The white light is spread out into a rainbow of colors into its component spectrum, as we call it, and this grating effect, of course, has been known for many, many, many years.

Well, now, the wave length of X-rays is only about one ten-thousandth as long as ordinary white light, say yellow light, and under ordinary conditions such as grating, where we have these fine lines alternately scratched, and then, of course, transparent, those lines could not be mechanically ruled closely enough together so that under ordinary conditions we could produce diffraction of X-rays by such a grating. We know now how to do it, but in the days of Roentgen and his contemporaries they did not know how to do that, so from 1895 to 1912 there were no lines closely enough together, or planes known, until, as I said, suddenly this German physicist discovered that we are simply surrounded on all sides by perfect diffraction gratings, simply because in a crystal, which has its perfectly defined parallel faces, which indicates, of course, a very definite internal arrangement, also, we have the atoms and the molecules, the ultimate atoms and molecules lined up on planes which have a spacing between them, the same order of magnitude as the wave length of the X-ray beam, namely, say one Angstrom unit, or ten to the minus eighth power centimeters, one one hundred

thousandth of a cent meter, so because we have those compatible dimensions a crystal then serves to break up the X-ray beam, or these X-ray beams, so to speak, curls around this equidistant parallel arrangement.

Of course, the phenomenon is actually more complex, because secondary X-rays are generated, and those interfere in accordance with perfectly definite optical laws, and go off in perfectly definite directions.

Q. Well, all right, go ahead.

A. Now, this, utilizing, then, this phenomenon of diffraction, it is at once evident that we are dealing with an examination far beyond the powers of a microscope, as regards the actual identity of the crystalline structure of any particular substance, and if we use X-rays, whose wave lengths are known, and produce such a diffraction pattern on a photographic film or plate by these definite laws of optics we may interpret that pattern produced by the bending of these rays by a particular architectural plan in terms of exactly what that plant is, in this ultimate sense. Consequently, we may use this method to identify given substances and to differentiate between different kinds of chemical substances, by virtue of the fact that each pure chemical compound has its own perfectly definite architectural plan.

By Mr. Whitcomb:

Q. Have you recently made some examinations of some samples delivered to you from Dr. Wilson?

A. We have.

Q. Well, will you go ahead and outline the technique you employed in connection particularly with this X-ray examination, first.

A. In beginning this examination some time ago we utilized the methods, the so-called diffraction meth-

ods then available, and, of course, incidentally discovered that these products which are of interest to all of us here instead of being amorphous were distinctly crystalline, though very, very finely powdered, yet did this produce a distinct, definite crystalline pattern, and it was perfectly well indicated also we were dealing with mixtures.

Now, in the first work, the first technique which we utilized, we found not a very satisfactory result, because of the very long time required for producing these patterns. Of course, lead is a heavily absorbing substance. The technique at that time, three, four or five years ago, consisted in placing a powder in a fine glass capillary, or in some other suitable container, and with the apparatus then available adjusting that in a beam of X-rays from a molybdenum target X-ray tube. These exposures required many hours, sometimes as many as forty-eight or sixty hours or more. The films which were produced were not very satisfactory, and by virtue of this long time exposure were fogged, obscuring quite definitely any faint lines which might be due to the presence of any materials present in small amount.

We began then a development or a study of technique with the following things in mind, first, very materially cut down the time of exposure, down to a very minimum, so that in the course of exposure we would not be subject to the possibility that the sample was changing during that long time; secondly, to produce—

Q. Now, pardon me,—

A. Yes.

Q. —how did you do that? What did you actually do for that number one?

A. We utilized then the most powerful X-ray tubes available upon the market, that run at very

much higher currents, with very much higher intensity of X-ray beam, installing the so-called Philips Metallix tubes, made in Holland. These were copper target tubes with very thin Lindemann glass windows. Instantly, by running these at their maximum capacity, we found that we could make exposures in one hour or less, as compared with two or three days, or very, very many hours by previous trials with our previous apparatus.

Q. What about the sample itself?

A. The sample, we did not, of course, want to enclose, if possible, anything nor introduce any extraneous effects of any kind—

By The Court:

Q. Now, when were those examinations made? Were you talking about three or four years ago,—

A. Well, I am just—

Q. —or are you talking about now?

A. Well, I am coming to the technique which we have used in all these later examinations.

Q. Well, I say, but when you started to develop this technique—

A. Yes.

Q. —it wasn't on samples of lead, was it?

A. Well, no, no.

Q. Well, that is what I mean.

A. It had to do with all of our general researches.

Q. Sure, I understand it.

A. Yes.

Q. That is what I want to get clear. Go ahead.

A. We wanted to avoid the necessity of using any containers, but at the same time making it perfectly definitely sure that the sample was not changing during any exposure. This was accomplished by the de-

sign which is generally familiar to X-ray people, a cylindrical camera which could be—in which the exposures could be made in vacuo, or in any inert gas in which the sample could be kept at low temperatures or controlled in any way necessary.

The sample was prepared as a wedge shaped sample in this inert atmosphere or in vacuum, so that the X-ray beam, this powerful X-ray beam, would pass across the edge of the wedge-shaped sample and register on the photographic film.

With these experiments then it was found that a sample, an exposure could be made very, very much more quickly, that the X-ray film produced had a very clear background for the purposes of microphotometry, and that under these conditions samples in which we are specially interested here could be studied in very short times of exposure, without change.

By Mr. Whitcomb:

Q. What about the wave length?

A. We utilized, as I say, copper target tubes, not only for the purpose of producing a powerful beam, but also for the purpose of gaining a greater resolution, a greater distance between lines. We have with molybdenum radiation, which is very commonly used, a predominating wave length of .71 of an Angstrom unit. With copper we have a predominating wave length of 1.54 Angstrom units. Then we have nearly, in a sense practically double the dispersion and resolution of the path, so that lines very, very close together could be spread apart and more easily analyzed.

Q. Then, as I understand it, from your method you have permitted your pictures to spread the lines

out more, so that you could pick them out more easily?

A. Yes.

Q. What about the materials tested themselves, did you use all one material or did you separate any parts thereof? If so, please explain that.

A. In the course of the examination of these lead oxide materials we have made at least five hundred separate diffraction films.

By The Court:

Q. Now, when you say "these lead oxide" do you mean the samples that Dr. Wilson submitted, or do you mean all the lead oxide—

A. All the lead oxides we have studied.

Q. All right.

A. The samples submitted by Dr. Wilson, samples from the Prest-O-Lite Storage Battery Corporation,—

Q. I see.

A. —samples which we prepared ourselves, and so on.

Q. All right.

A. Including one hundred and twenty-five separate experiments on the decomposition of lead oxalate.

By Mr. Whitcomb:

Q. While you are on that you might explain briefly what was the object in that.

A. It has been known for a great many years, or even from the time of Berzelius, that lead oxalate, a pure chemical compound, when heated in a vacuum, dissociated or decomposed into an entirely new substance, under ordinary conditions a velvety black substance, to which these chemists, Berzelius included,

and subsequent men, assigned the name lead suboxide.

We find in the literature many references to this reaction. Of course, there has been disagreement by various authorities in the literature, the chemical literature, as to just what is produced by the dissociation of lead oxalate. It has seemed very advisable, therefore, to study the process, this chemical reaction, very thoroughly, not only for the purpose of seeing whether such a thing as lead suboxide did exist, but to study a molecule, to study this reaction in the sense of a molecular dissociation, where a molecule, a single chemical molecule breaks down into other species of molecules, and, of course, it follows that depending upon the conditions of temperature and time and gaseous atmosphere, equilibrium, and so forth, that widely different products might be expected from the dissociation of lead oxalate. These experiments were undertaken, therefore, as simply a fundamental series of experiments of molecular dissociation in the attempt to prepare, if such a thing did exist, lead suboxide in as pure form as possible, and consequent y these, about one hundred and twenty-five experiments—

By The Court:

Q. What is lead oxalate?

A. Lead oxalate has the formula PbC_2O_4. Oxalate is—oxalic ac d is a well-known organic acid, and it is a salt formed between lead and oxa ic acid.

By Mr. Whitcomb:

Q. Did you succeed in discovering the suboxide?

A. As we proceeded with these experiments it became immediately apparent upon first examination of the films that there were the well-known diffraction

lines for metallic lead, well-known diffraction lines for red tetragonal, lead monoxide,—

Q. PbO?

A. PbO, and under some—

By The Court:

Q. Is that what they call litharge?

A. Yes.

Q. PbO?

A. PbO, litharge. Your Honor, we might make it clear that there are two kinds of PbO, two crystalline forms of PbO. One crystallizes in the tetragonal system, so-called red, although the color means little or nothing, stable at lower temperatures, and another compound. PbO, same chemical composition, which crystallizes in the orthorhombic system, which is stable at high temperatures, so we are speaking now of a single variety.

Q. Yes.

A. Single pure variety of one of these two forms, crystalline forms of lead monoxide, or litharge.

In addition to those lines which predominate upon the pattern—

By Mr. Whitcomb:

Q. These two?

A. These two.

Q. Metallic lead and PbO?

A. Metallic lead and PbO—there appeared additionally in some of the samples, not all of them, depending upon the temperature, additional lines, due to some additional substance, crystalline substance. These lines could not be accounted for as beta lines. By beta lines we mean lines due to another weaker component in the X-ray beam. They could not be assigned to metallic lead. They could not be assigned

to red tetragonal PbO or to orthorhombic PbO. A careful analysis of these lines, many of which were very, very close to the other lines, and some of which actually were superimposed upon other lines, indicated a new type of structure, which fit a cubic lattice, and which in general correspond—

By THE COURT:

Q. Which fit a what?
A. Cubic, cubic crystal structure.
By MR. WHITCOMB:
Q. Cubic lattice?
A. Cubic lattice, yes.

THE COURT: Lattice.

THE WITNESS: In general corresponding to results which were reported in 1926 by an Italian by the name of Ferrari.

These experiments then were continued, always producing variations, trying to produce greater quantities of this additional substance. The greatest amount which we have ever been able to produce, at 310 degrees centigrade, in vacuum, was 29—nearly thirty per cent of this additional substance, additional to metallic lead, or to red tetragonal PbO.

The conclusion, therefore, is based upon these films, prepared with the greatest care, and careful microphotometry, curves which we can demonstrate, is that this mooted substance lead suboxide, does actually exist, although it may be a very unstable, a relatively unstable, a very unstable substance.

By THE COURT:

Q. Well, now, may I ask you whether that con-

c'usion is in conflict with what Dr. Wilson says on page 7, which is, "First, lead suboxide does not exist in the pure condition. The black powder obtained first by Berzelius by heating lead oxalate in a vacuum is not pure Pb_2O."

A. If we take—

Q. Is the conclusion you have stated in conflict with that?

A. No, that is exactly right, we take the final product, as produced by lead oxalate, or by other processes, we cannot under any conditions which we have yet found, at any rate, produce Pb_2O to the exclusion of these other two components.

Q. You mean you cannot separate it from the others?

A. We cannot separate it, but I mean in the mixture, the compound, the powder which is actually produced, we have a mixture rather than a single constituent.

Q. I have an idea, it might be important, and if it is I don't understand it, I don't know what you mean by the thing existing but not existing.

MR. WHITCOMB: In the pure condition.

THE COURT: In the pure condition.

THE WITNESS: Yes.

By THE COURT:

Q. And then you say you can separate it?

A. Yes.

Q. Well, but how can you separate it, if it exists and you can separate it, why won't you get it in the pure condition?

A. Well, we can, Your Honor, produce it in practically pure condition by separating it from this mix-

ture prepared at high temperatures, and that is a new series of experiments in which we utilize a supercentrifuge.

Q. Well, that is all right,—

A. Yes.

Q. —but then that certainly is in conflict with the statement that lead suboxide does not exist in the pure condition, to my mind it is, anyhow.

A. Yes.

Q. Now, there may be something that I am missing in your way of using words, but I don't know.

A. Dr. Wilson, of course, has in mind, and if we consider his idea there that lead—that the production, the actual production of lead suboxide by one step, by some chemical process, will not produce pure lead suboxide by any known combination of things that we know now. We have to resort to a further step, taking this mixture, containing these three separate compounds, very intimately mixed up together, and then attempt by some additional physical means to pick out or take away these three apart from each other.

Q. Well, but you say you can do it?

A. We can do it, yes.

Q. Well, but, then, that certainly, to my mind, is in conflict with the statement that lead suboxide does not existing in the pure condition.

A. Yes.

Q. Because, after you do it, you get it—

A. We have it.

Q. —in pure condition.

A. Essentially pure condition.

Q. Then it does exist—

A. It does exist.

Q. —in the pure condition?

A. Yes.

Q. So that that statement is directly in conflict, as I read it, with Dr. Wilson's statement.

A. These facts, of course, were not known at the time of the writing of this report.

Q. Well, I know, but that is not what I asked.

By Mr. Whitcomb:

Q. How recently have you operated the centrifuge machine and come to those conclusions?

A. This has been within the past month, in August.

Q. Well, now, will you go back and take your samples and your films in the order that you received them, we will come to this again when you take them in the regular order, as tested by you, in the films which you made to show the proof of what you found in the various samples.

A. I would like to submit to you a series of typical films or X-ray spectra illustrating the points which I have just mentioned, fourteen—yes, fourteen different spectra, containing various pure substances, orthorhombic lead oxide, test lead, tetragonal lead oxide, oxide from Japan, Prest-O-Lite mill oxide, Exide oxide as sent to us by Dr. Wilson, various fractionated samples—another sample sent—D-4-O—sent by Dr. Wilson, a spectrum of a lead ball taken from the Exide mill, D-5-2, and the last spectrum the film for the dissociation of lead oxalate under conditions producing a maximum amount of lead suboxide.

Q. This is a base log to which you desire to refer for comparative purposes?

A. Yes.

Mr. Whitcomb: Counsel for plaintiff would like to offer in this chart with the attached note showing what each film means, and asks the clerk to mark the same Plaintiffs' Exhibit 21.

(Chart submitted by the witness Clark was marked Plaintiffs' Exhibit 21.)

By Mr. Whitcomb:

Q. Will you take them in order, one by one, so we won't get too many, without interfering with your own method of procedure, however?

A. Yes, well, I don't know—

Q. Preferably in the dates in which you received samples from Dr. Wilson.

A. Yes, samples were received from Dr. Wilson as prepared on May the 25th—

Q. What year?

A. —and June 21st, of 1934, oxides, lead oxides, original fines through a 170 mesh screen and coarse 170 mesh screen, and also lead balls from these mills. They were delivered to us July the 2nd, 1934, one lot of them, and another lot on the 23rd of August, 1934.

Films of each one of these were carefully prepared, measured, and subjected to microphotometer analysis. I have here the original microphotometer curves for those samples submitted by Dr. Wilson, together with comparative microphotometer curves for the films illustrated in this tabulation, especially the one from lead oxalate.

Q. Will you produce—

A. From these—

Q. Have you got the film for the first sample you received?

A. I have.

Q. Will you produce it?

A. These are original negatives for the entire group of samples received from Dr. Wilson.

Q. Just a moment,—

A. Certified by me on the 9th of July, 1934. Those are original negatives.

Q. Well, did you designate the first sample by a number of some kind?

A. We did.

Q. What number was the first one?

A. D-1.

Q. D-1. Have you got the film for D-1?

A. We have, there are three films for D-1.

Q. Three films?

A. One is the original oxide, one is for a fine fraction screen of 170 mesh, and D-1-C is 170 mesh coarse fraction.

By The Court:

Q. What was that, where was that taken from, and what was it?

By Mr. Whitcomb:

Q. What is that sample?

Where is it purported to be from?

A. Run 21, mill number one, time 2.10 P. M., under the screen May 25th, 1934, initialed by J. Hunt Wilson.

By The Court:

Q. Well, that was the ordinary run—

A. Yes.

Q. —of their mill?

A. Yes.

The Court: That is all I wanted to know.

Mr. Whitcomb: Shall we introduce the material, do you think?

The Court: Well, whatever you want to do, I don't know. What do you mean?

Mr. Whitcomb: Do you think it is necessary

to introduce the material itself? It is all right to introduce it. Maybe you don't want to bother with the material.

THE COURT: I won't bother with it, whatever happens, somebody else will bother with it. I don't care whether it is introduced or not.

MR. WHITCOMB: I think so, then. The thing is here.

THE COURT: All right.

MR. WHITCOMB: Counsel for plaintiff offers in evidence the first sample, marked run 21, and asks the stenographer to mark the same Plaintiffs' Exhibit number 22.

(Sample of material was marked Plaintiffs' Exhibit number 22.)

MR. WHITCOMB: Counsel for plaintiffs offers in evidence the three films relating to sample exhibit number 22 as Plaintiffs' Exhibits 23, 24 and 25.

THE COURT: I think you can probably save time by offering all these things at one time, and having them marked.

MR. WHITCOMB: Yes.

THE COURT: Reserve a string of numbers for them.—

MR. WHITCOMB: Yes, all right.

THE COURT: —because I don't think there will be any dispute as to the identification of them.

MR. WHITCOMB: No.

By Mr. Whitcomb:

Q. There are the films. Have you got photographs of these, or not?

A. We haven't got the photographs of all of them. We have simply the quantitative analysis from them and simply representative ones.

The Court: Pardon me, each one of these samples bears Dr. Wilson's or somebody's notation of what it is?

Mr. Shaffer: Dr. Wilson's.

Mr. Whitcomb: Yes.

The Court: Now, I suggest that it be agreed that they shall all be offered in evidence, with the understanding that they are what they purport to be by these labels.

Mr. Morris: May I see just a moment? I think we would have no question about it.

The Court: Yes, it would save a lot of time.

Mr. Morris: I think the same agreement would run both ways.

The Court: Oh, yes.

Mr. Whitcomb: Oh, sure.

Mr. Morris: Anything bearing Dr. Wilson's initials we won't have any objection to at any time, but for the purpose of clarity, one of my associates suggested that if the material be given one number and the films produced by the witness be given a separate number it would help to keep the record a little bit clearer.

The Court: Yes, well, sure.

MR. WHITCOMB: Sure, we will do that. Well, we will reserve that for a moment. We will introduce them all at once, after while.

By MR. WHITCOMB:

Q. Have you a chart showing the sample numbers and any charteristics that you found existent in the samples you tested?

A. As I stated, each of these films is subjected to microphotometric analysis by these curves on a highly sensitive and accurate microphotometer, which serves simply to convert lines into peaks, graphically represented as a curve on sensitized paper, from these curves.

THE COURT: What do they look like? Let me see them?

By MR. WHITCOMB:

Q. Will you show those?

A. All right.

(The witness produced the records.)

By THE COURT:

Q. That is the same as these plates, only translated into—

A. That is right.

Q. What do the high peaks mean, stronger line?

A. Strong line, yes.

Q. Yes.

A. And a low peak indicates a weak line.

By MR. WHITCOMB:

Q. And the spacing—

A. Spacing, of course, represents the identification of the lines, to what constituent it belongs.

These curves were then subjected to analysis, quantitative analysis, and this chart represents, with a constant height for metallic lead, keeping the metallic lead constant, represents the relative proportions of red tetragonal PbO and cubic lead suboxide.

THE COURT: Now, you are getting into trouble here because you are not identifying any of these exhibits. When you come back to read it over it is going to be hard.

MR. WHITCOMB: I think we ought to introduce all those exhibits now.

THE COURT: Well, let's start in now with these samples. How many of those are there?

MR. SCHAFFER: Six.

THE COURT: What?

MR. SCHAFFER: Six.

THE COURT: All right, then they will be introduced as Exhibit P-22.

MR. SCHAFFER: Plaintiff offers in evidence six tubes, six sealed glass tubes containing powder taken from Defendant's mill, furnished by Dr. Wilson, and asks that they be marked Exhibits 22, 22-A, 22-B, 22-C, 22-D, 22-E, and 22-F. Now, do you want me to identify the data?

THE COURT: No, it won't be necessary, you just mark them.

MR. SCHAFFER: All right.

(Six sealed tubes of powder from defendant's mill were marked, respectively, Plaintiffs' Exhibits 22-A, 22-B, 22-C, 22-D, 22-E and 22-F.)

MR. WHITCOMB: Now, get your set of films for each of those.

MR. SCHAFFER: Plaintiff offers in evidence the films made from Exhibit 22-A, three films, and asks that they be marked 23-A-1, A-2 and A-3.

(Films relating to Plaintiffs' Exhibit 22-A were marked Plaintiffs' Exhibits 23-A-1, 23-A-2 and 23-A-3.)

(Discussion off the record.)

THE COURT: I think when you get through with that we might recess for a few minutes.

MR. SCHAFFER: All right.

THE COURT: Take a few minutes more, we will recess until half past eleven.

(Recess, 11.15 to 11.30 o'clock A. M.)

MR. SCHAFFER: Plaintiff offers in evidence three films corresponding to sample, Exhibit 22-D, marked 23-D-1, 2 and 3.

(Films relating to Plaintiffs' Exhibit 22-D were marked Plaintiffs' Exhibits 23-D-1, 23-D-2 and 23-D-3.)

MR. SCHAFFER: Plaintiff offers in evidence three films corresponding to the sample 22-E, marked 23-E-1, 2 and 3.

(Films relating to Plaintiffs' Exhibit 22-E were marked Plaintiffs' Exhibits 23-E-1, 23-E-2 and 23-E-3.)

MR. SCHAFFER: Plaintiff offers in evidence Exhibit 24-A, microphotometer curve, corresponding to films, 23-A-1, 2 and 3.

(Microphotometer curve relating to Plaintiffs' Exhibits 23-A-1, 23-A-2 and 23-A-3 was marked Plaintiffs' Exhibit 24-A.)

MR. SCHAFFER: Plaintiff offers in evidence Exhibit 24-D, microphotometer curve corresponding to films, Exhibits 23-D-1, D-2 and D-3, and also corresponding to films Exhibits 23-E-1, 2 and 3.

(Microphotometer curve relating to Plaintiffs' Exhibits 23-D-1, 23-D-2 and 23-D-3, and 23-E-1, 23-E-2 and 23-E-3 was marked Plaintiffs' Exhibit 24-D.)

MR. SCHAFFER: Plaintiff offers as Exhibit 22-G lead ball taken from defendant's mill by Dr. Wilson and submitted to plaintiff for examination.

(Lead ball from defendant's mill was marked Plaintiffs' Exhibit 22-G.)

MR. SCHAFFER: Plaintiff offers in evidence Exhibit, 23-G-1, 2, 3 and 4, which are films of X-ray analysis of lead ball, Plaintiffs' Exhibit 22-G.

(Films relating to Plaintiffs' Exhibit 22-G were marked Plaintiffs' Exhibits 23-G-1, 23-G-2, 23-G-3 and 23-G-4.)

MR. SCHAFFER: Plaintiff offers in evidence lead ball received by Dr. Clark from Dr. Wilson on August 18, 1934, marked Exhibit 22-H.

(Lead ball was marked Plaintiffs' Exhibit 22-H.)

MR. SCHAFFER: Plaintiff offers in evidence films of X-ray analysis of lead ball, Exhibit 22-H, marked Exhibits 23-H-1, 2, and 3.)

(Films relating to Plaintiffs' Exhibit 22-H were marked Plaintiffs' Exhibits 23-H-1, 23-H-2 and 23-H-3.)

MR. SCHAFFER: Plaintiff offers in evidence Exhibit 24-G, which is the photometer curve of films Exhibit 23-G-1, 2, 3 and 4.

(Photometer curve relating to Plaintiffs' Exhibits 23-G-1, 23-G-2, 23-G-3 and 23-G-4 was marked Plaintiffs' Exhibit 24-G.)

MR. SCHAFFER: Plaintiff offers in evidence Exhibit 24-H, which is a microphotometer curve of films, Exhibit 23-H-1, 2, and 3.

(Microphotometer curve relating to Plaintiffs' Exhibit 23-H-1, 23-H-2 and 23-H-3 was marked Plaintiffs' Exhibit 24-H.)

MR. SCHAFFER: Plaintiff offers in evidence Exhibit 23-I, 1 and 2, which are X-ray films of powder received from Dr. Wilson, mill number 3, run number 31, August 3, 1934. Number 23-I-1 is the screen product; number 23-I-2 is the finished product.

(X-ray films of powder from mill number 3, run number 31, August 3, 1934 were marked Plaintiffs' Exhibits 23-I-1 and 23-I-2.)

MR. SCHAFFER: Plaintiff offers in evidence Exhibit 24-I, which is the photomicrometer curve of Exhibits 23-I, 1 and 2.

Q. Exhibit No. — ?

(Photomicrometer curve relating to Plaintiffs' Exhibits 23-I-1 and 23-I-2 was marked Plaintiffs' Exhibit 24-I.)

By Mr. Whitcomb:

Q. Then will you produce the chart you have showing graphically the results of the tests from the samples, and state what it is?

A. From the microphotometer curves, an analysis was made of the amounts, relative amounts of red tetragonal PbO, metallic lead, and lead suboxide which was given a percentage of lead suboxide on this sheet, and these results are graphically represented in this diagram in which lead is given a constant height and the relative amounts of the red tetragonal PbO and lead suboxide are shown corresponding to the samples, and so on we have shown by comparison. At the bottom are shown three samples produced from the decomposition of lead oxalate C83, C113, C119.

Mr. Whitcomb: Counsel for the plaintiffs offers in evidence the typewritten sheet produced by the witness, and asks the Clerk to mark the same Plaintiffs' Exhibit No. 25, and the blueprint diagram which is produced, and ask the Clerk to mark this Plaintiffs' Exhibit No. 26.

By Mr. Whitcomb:

Q. Will you now please take one of your films and your microphotometer charts and show the court, on, say, the very first sample you tested that was given to you from Dr. Wilson, and show where you find suboxide?

THE COURT: Now, you are going through one sample just to show me how to find it, and I will assume the procedure is the same in all the other samples?

MR. WHITCOMB: Yes.

THE COURT: All right, go ahead.

By MR. WHITCOMB:

Q. Which exhibit are you looking at?

A. Let's see; maybe we better have the one that is already designated. We can produce in evidence a little later a chart which Dr. Wilson has in his possession on a large scale with colored inks, the drawings which show these various lines corresponding to each one, No. 3 in this—

Q. Exhibit No.?

A. Exhibit No. 21 is a crystal spectrum for essentially pure orthorhombic lead oxide. No. 2 is test lead, pure lead, each line, each spectrum resulting in a pure constituent. No. 3 is red tetragonal lead oxide.

By MR. SCHAFFER:

Q. PbO?

A. PbO. Now, these reproductions, of course, are not to compare with the original negatives particularly because these lines are faint, but in order to see what I want to have you see we will look at spectra Nos. 9, 10, and 11, the principal lines of which correspond to lead suboxide. These spectra were produced by the use of super-centrifuge upon the above samples prepared from the mill.

Super-centerfuge belongs to the geological survey of the State of Illinois. There were several reasons for doing this, of course, one being to try to fractionate the three materials into individual fractions. It

was impossible to predict ahead of time what we would get.

But several series of experiments were run, one of the first being to suspend the material, divide the material in a very pure, light oil, subjecting it to super-centrifuge fifty thousand r. p. m. Taking, then, the non-settling fraction of fifty thousand r. p. m., and at low temperatures carefully removing the oil, and from this fraction, that is, the finest fraction non-settling at fifty thousand r. p. m., making the X-Ray spectrum.

We had no way of knowing ahead of time whether that would be lead, lead oxide, or lead suboxide, but the spectra 9, 10 and 11 present the purest spectrum of lead sub-oxide that undoubtedly has ever been obtained.

By Mr. Whitcomb:

Q. You mean that all on lines?

A. Not all of them. There are a few faint lines corresponding to an additional substance, probably a minute amount of carbonate, or something of that sort, whole spectrum, this one right here over the so-called two hundred and sixty line.

Q. These red spots down here don't identify anything?

A. Those are ink spots. Then, of course, if you take this two hundred and sixty line up through the other materials I think you can see evidence, even in this rather poor reproduction here. Some of the other lines, of course, are superimposed directly on top of some of these other lines; you have to separate those out. But the composite of lines gives us a structure which is consistent with a cubic structure with a lattice fraction of 5.38, if I remember rightly, Augstrom units.

In all of these materials fractioned, namely, Exide prepared at the Shimadzu mill, and the Prest-O-Lite, and in the Exide process, and in the Exide mill it has been possible to concentrate in the finest non-settling fraction of high proportion of sub-oxide of lead.

This substance is - ample, of course, a very small amount he subjected to temperature in the absence of air disassociated, became black. In the presence of air it oxidized instantly, changed in color to yellow and formed letharge PbO.

Q. Please explain more in detail the use of this supercentrifuge. Is that like a cream separator, or something in a common way, so that we will understand it?

A. Yes, it is. The super-centrifuge is simply a means of modern chemical physical method of factionating extremely finely divided substance in a colloidal range, and it is called a super-centrifuge not only because of its careful construction, but also because of its high speed. Of course, the factionation takes place by view of the centrifugal force. In the liquid phase it is not separated at fifty thousand r. p. m. I think it is very interesting that this finest fraction does consist essentially of this phase, which is present in small amount in the original oxide. It is not lead and not lead monoxide.

By The Court:

Q. What did you put in this super-centrifuge before you tried to fractionate the stuff?

A. For example, take the original mill oxide.

By Mr. Whitcomb:

Q. From Dr. Wilson?

A. Yes.

By The Court:

Q. That is all No. 9?

A. Yes.

Q. The same as 10 and 11?

A. Yes.

Q. They were all fractions of the original mill oxide?

A. That is right?.

By Mr. Whitcomb:

Q. Will you please point out some of these microphotometer curves?

A. For example, an examination of D1F, which is according to our nomenclature Exhibit No. 24A shows a well defined peak which is labeled 2.63.

Q. What is that peak?

A. This is an automatic microphotometer. You can see that is on silver bromide paper. In most of these cases, of course, we can use any lines, but the 2.63 line is an unusually good one because it stands out well resolved from the other lines.

Q. You may mark an "X", and mark it Pb_2O on that exhibit?

A. Yes. (The witness complies.)

Q. Now, have you made any other type of examination of any of these samples?

A. You refer to the experiments of lead ball, the X-Ray experiments of lead ball, do you not?

Q. I understood you have films there showing that?

A. Yes.

Q. Show the Court. What you have on these films you have spoken about applies equally well to all these other films you have produced, is that correct?

A. Yes. I might say these experiments with the lead ball taken from the mill was made in successive layers from the very outside clear down into the solid metal so that any layer effect of any kind would be brought out.

Q. Did you find the sub-oxide present in those samples?

A. Suboxide was present as a protective layer under the outside layer. This tabulation on the typewritten sheet will show the concentration of lead suboxides runs up to twelve and fourteen per cent., three or four times as much in an underlying protected layer on the lead ball as in the oxide that is in the outer layer, or in the yellow Exide.

Q. As to amounts or quantities, did you find more evidence of the sub-oxide in the samples in the mill or in the product taken out of the mill?

A. The highest concentrations we have found in the mill product was found in the layer under the surface on the lead balls taken from the mill as shown by the typewritten sheet attached to the exhibit.

Q. Now, have you made any other methods of examining these samples?

A. We have.

Q. What methods?

A. Microscopic examinations.

Q. Have you got any results from that?

A. We have.

Q. What are they?

A. This exhibit No. —

A. I will introduce it. What is this exhibit?

A. This exhibit are photomicrographs made of powder as follows: a sample from the Shimadzu mill and the Prest-O-Lite Storage Battery Corporation, a sample of oxide from the Exide lead as submitted

by Dr. Wilson, a sample of oxide prepared in Japan by the Shimadzu process, a sample of powder prepared by the decomposition of lead oxalate, and a sample of Exide material which had been fractionated in super-centrifuge.

Q. You have got written on the side the names for each sample that you just mentioned?

A. Yes.

MR. WHITCOMB: Counsel for plaintiffs offers in evidence the record produced by the witness and asks the Clerk mark the same Plaintiffs' Exhibit No. 27.

By THE COURT:

Q. What does this show?

A. This powder, of course, is very opaque, and the microscopic examination is quite difficult because light will not readily be transmitted through it. Reflected light can be used, however. But in a very careful examination it was discovered in this mixture besides the very opaque dark masses which were very intimate combinations of lead and lead oxide, you could tell by the colorless metallic lead particles and particles of Exide scattered through that little clump of an additional third substance, strangely enough, considerably more transparent in very thin layers. if you will examine in the first row of Pl. 2, right in the middle of the right-hand one you will see a little clump of crystals.

Q. The next row is the big one?

A. That is right.

Q. That, you say, is Pb_2O?

A. That is Pb_2O. That is common to all of these substances. We were able to measure the fractive index, which is different completely from the other

materials. In polarized light these crystals are completely distinguished, that is, after we rotate the scope of the microscope, the crystal doesn't come in and disappear as it would with anything but a cubic crystal. It is an isotropic substance in polarized light.

Now, another thing about E12 on the right-hand side, one of these microscopic slides could be taken and carefully heated on an electric plate very quickly, and you will observe on the left-hand pattern, or on the left-hand side the beginning darkening, so that the rhombohedron crystal is beginning to change in its properties, becoming opaque, and it is very interesting to follow that process.

By The Court:

Q. How much is this magnified?

A. Six hundred times.

Q. That piece would be visible to the naked eye, wouldn't it?

A. Well, if you had it just in the right place, probably it would. Six hundred magnification is, of course, pretty good magnification. We then made the micro-manipulator needles to try to separate these little crystals from the adhering opaque powder. We found these masses very brittle, easily broken apart, and it is simply impossible to bring them altogether in a single pile because of the ease with which they broke up. These are not single crystals, but are aggregates, very thin scale with these particular properties. Down in the factionated sample—

By Mr. Whitcomb:

Q. What one is that marked?

A. 94D-12; that is just our own mark. That is fractionated Exide corresponding to the second one

from the top. We find in the fraction of this sample just a complete fill of this relatively transparent material. Some of it is very, very small, just little tiny droplets. You can see some not quite in focus there on the left-hand side. These observations were independently confirmed by the professor of optical mineralology in the department of geology.

Q. What is his name?

A. W. V. Howard.

Q. He signed these sheets?

A. He signed these sheets, yes. There is, thus, no question but that an additional substance is present even in microscopic examination, although, of course, in small amount.

By The Court:

Q. But these pictures tell you what it is?

A. No.

Q. That you have got to get from your X-Ray?

A. Yes, and identification by refractive index.

Q. The only thing the X-Ray photographs tell you is something is there that isn't either lead or lead oxide?

A. Yes.

Q. That really don't tell you any more than that?

A. It tells you that it has a cubical crystalline structure which corresponds, that is, a third different substance corresponds fairly well with the first X-Ray analysis ever made.

Q. Let me ask you about the ordinary minute analysis. Take one of those tubes; if I gave you one to analyze, to tell me what it was, you probably would know by looking at it and by feeling it from the weight of it pretty well, wouldn't you?

A. You mean supposing you didn't know that it was lead?

Q. Didn't know what it was; suppose I gave you this tube and said, "Tell me what that is"; what would be your method of finding it out, or identifying it?

A. As a chemist I would, of course, subject it to qualitative analysis first to see if it were lead.

Q. How do you do that?

A. Dissolve the substance in a suitable solution and then make the specific test starting right at the beginning.

Q. To see what reaction took place when you added certain other things to it?

A. That is right. You destroy, of course, the original material.

Q. You wouldn't use a microscopic examination?

A. Yes, you would. There is a growing science of chemical microscopy, and oftentimes you can, especially if you use polarized light, you can identify it.

Q. You have no qualitative test for this lead suboxide?

A. There is none known so far as we know at the present time.

Q. The stuff, itself, assuming that it exists, as you say it does, is fugitive, isn't it? You can't keep it before you any length of time?

A. It is unquestionably an unstable substance.

Q. Is that only because the effect of air is more stable than a vacuum?

A. Yes, in our experiments with this fractionated phase, we were surprised by the relative stability if it is kept dry and out of air. It is especially sensitive first, to temperature even in vacuum, and second, to the dampness.

Q. Did you make these microscopic examinations in vacuum?

A. No, they were made very quickly in a dry room; powder was sprinkled on a brass plate.

By Mr. Whitcomb:

Q. Do you have any charts showing the lines of a spectrum that would be present for sub-oxide as you understand it, not taken from a picture, but built up by you?

A. I have; Dr. Wilson has that chart.

Mr. Whitcomb: If Your Honor please, at this point we would like the chart that Dr. Wilson has.

The Court: All right.

Mr. Whitcomb: I will have to get it and produce it after lunch.

The Court: That is all right. Do you want to stop now?

Mr. Whitcomb: I would like to.

The Court: All right; it is quarter after twelve, if you have to have that now.

Mr. Whitcomb: This is the proper time.

The Court: All right.

(Recess from 12.15 o'clock P. M. to 2.00 o'clock P. M.)

AFTER RECESS.

GEORGE L. CLARK, recalled.

Direct-examination (Continued).

By MR. WHITCOMB:

Q. Have you a chart showing the theoretical arrangement and construction of these lines that you have been talking about as produced by an X-Ray?

A. I have.

Q. Can you produce it?

A. I can.

THE COURT: Mark it exhibit—

MR. WHITCOMB: Plaintiff offers it in evidence as Exhibit number 28.

(Chart showing arrangement of lines produced by X-Ray was marked Plaintiffs' Exhibit number 28.)

By MR. WHITCOMB:

Q. Please go ahead, now, and explain to the Court what this is.

A. Your Honor, the crystal structures of silver oxide, Ag_2O, and Cu_2O, cuprous oxide, both are very well known, because those can be prepared easily in a pure state. The first spectrum here represents the crystalline structure of pure silver axide, Ag_2O. The second one—

By THE COURT:

Q. Why don't they call that suboxide?

A. Well, they could.

Q. I mean, it is the same symbol, isn't it?

A. Same symbol, the difference being, of course, that silver has ordinarily only one combining valence, as we call it. Of course, copper and lead both have two—

Q. All right.

A. — or more. The second is cuprous oxide, also well known.

Now, these two substances crystallize alike, so-called cuprite structure, which is cubic.

The third spectrum here gives a detailed, accurate representation of the lines which we observe for the so-called oxide, or the mill oxide, many of which we have seen this morning.

Now, presupposing that lead suboxide exists, and that it has a crystal form similar to silver oxide and cuprous oxide, both of which are well-known, and taking the spacing previously found, or practically previous spacing found by the Italian, Ferrari, we reproduce in the fourth line the spectrum of pure lead suboxide, if such did exist.

Then the fifth line is pure lead, a yellow ink.

Tetragonal lead is in the green ink.

By The Court:

Q. Do you get the fourth line by subtracting the lines you find in the fifth and sixth from the third?

A. That is right, and this one here is—this is the spectrum subtracted.

By Mr. Whitcomb:

Q. Did you get this by subtraction? This is not Ferrari's pattern?

A. No, this is by subtraction from this.

By The Court:

Q. That is, the fourth line?

A. That is the fourth line.

Q. In other words, when you say that, the fourth you get by subtraction from the third?

A. That is right.

Q. Let me ask you, why had you reproduced the silver and the copper oxide there?

A. Simply because this demonstrates that lead suboxide, or this third constituent, has a crystalline structure similar to silver oxide and cuprous oxide, both of which are well-known.

Q. Is that demonstrated by the place where the lines are found?

A. And the pattern of lines, yes, you can see the two lines. There are, of course, slight variations.

Q. Yes.

A. Two here and one here, and so on.

THE COURT: All right.

MR. MORRIS: Is there a legend on that?

THE COURT: No, it is just marked P-28.

MR. MORRIS: I wonder if it wouldn't be well to have the legend?

THE WITNESS: Yes, I would be very glad to write that on.

THE COURT: All right, write on what it is.

MR. WHITCOMB: Well, of course, the chemical formula is there.

MR. MORRIS: Oh, I didn't know that.

THE COURT: Will you let me see it, then? I mean, are you through with it now?

MR. WHITCOMB: Yes, I think we are.

By Mr. Morris:

Q. May I ask what the legend is on the one that most nearly resembles Ferrari? Is that Pb_2O?

A. Pb_2O, yes.

Q. But that is not the Ferrari pattern?

A. No, that is the pattern made by subtracting the one with yellow and green ink from the total pattern.

Q. What are these two?

(Mr. Morris indicated the fifth and sixth charts on Plaintiffs' Exhibit number 28.)

A. That is pure lead and tetragonal PbO.

By The Court:

Q. Pardon me, but what is the little rectangle here to the left? Why is that separated from the long strip?

A. That is a matter of technique in the taking of the photographs, if we arrange our film in the cylindrical camera it is possible to reproduce lines on both sides of the zero, see?

Q. Oh, all right.

A. That is made purposely to show if we do reproduce lines on both sides of zero we can determine their position accurately by measuring from one side to the other.

Q. All right. Oh, it is the same thing starting again.

A. That is it.

Q. It is the same strip starting again?

A. That is it.

Q. If it was produced to the left you would get the same thing?

A. Same thing just in reverse, that is all.

By Mr. Whitcomb:

Q. Now, amongst these films that you have produced this morning please pick out and show to the Court the one you took from the actual sample and in your opinion illustrates the suboxide on this last Exhibit number 28.

A. Well, those are, the films representing this fractionated sample are the ones which correspond most—

Q. Please find it exactly.

(Discussion off the record.)

By Mr. Whitcomb:

Q. Aren't they all here, or have been introduced?

A. No, we haven't introduced the fractionated films yet.

Q. Have you got those?

A. Yes, sir.

Q. I understand you haven't introduced them this morning, have you got them with you?

A. I have.

Q. Will you now produce them?

A. I now produce the following films, number 94B, Exide, oxide received August 24, 1934, from Dr. J. Hunt Wilson, finished product, finest fraction of non-settling phase, centrifuged out at fifty thousand r. p. m. for one and one-half minutes; sample, and so on.

Mr. Whitcomb: Counsel for Plaintiff offers in evidence a film produced by the witness, and asks the Clerk to mark same Plaintiffs' Exhibit number 28-A.

(Film taken of sample of Exide oxide number 94B was marked Plaintiffs' Exhibit number 28-A.)

THE WITNESS: This is the same thing for Prest-O-Lite oxide, made by Shimadzu.

THE COURT: May I have that just a minute, Judge Morris?

MR. MORRIS: I was wondering whether that last exhibit corresponded—

THE COURT: That is what I was going to ask, exactly.

By THE COURT:

Q. Looking back at 21, those exhibits that you are referring to now, are they reproduced—

A. Yes. Just hand me that.

MR. MORRIS: The film that he just offered in evidence, however, should correspond to one number on there, as I understand it.

THE WITNESS: Yes, number 10 on here is a reproduction of, a print of the film—

THE COURT: I see.

THE WITNESS: — which is just introduced.

THE COURT: All right.

MR. WHITCOMB: 28-A.

By MR. WHITCOMB:

Q. Then Exhibit 28-A is the film from which the photograph number 9—

A. This is number 10.

Q. Number 10 on Exhibit 22, is that correct?

A. That is right—21.

Q. That should be 21, Exhibit 21.

MR. WHITCOMB: The second film you just produced counsel for plaintiff offers in evidence

and asks the Clerk to mark same Plaintiffs' Exhibit 28-B.

(Film taken of sample of Prest-O-Lite oxide was marked Plaintiffs' Exhibit number 28-B.)

MR. MORRIS: I wonder if it would interrupt too much if we can get on one of these copies of ours the corresponding original film and whether we may have that exhibit so we can keep them parallel?

THE COURT: Yes. Who has it. The witness has to have it, too.

MR. SCHAFFER: I think I have a copy.

MR. MORRIS: That is all right, we have another one.

By MR. WHITCOMB:

Q. This is 28-B, is there one that corresponds to that?

A. That is number 9.

Q. Exhibit—

A. Number 9 corresponds to Prest-O-Lite.

Q. Number 9 of Exhibit 21 corresponds to Exhibit 28-B, that is correct?

A. This is—9, 10 and 11 represented fractionated samples. This is the third one of those three, also Prest-O-Lite.

MR. WHITCOMB: Counsel for Plaintiff offer in evidence the third film produced this afternoon by the witness, and asks the Clerk to mark the same Plaintiffs' Exhibit 28-C.

(Film made of sample of Prest-O-Lite oxides was marked Plaintiffs' Exhibit number 28-C.)

By Mr. Whitcomb:

Q. And that corresponds to what?

A. Number 7.

By Mr. Morris:

Q. Number 7, or 11?

A. 7 and 11, 7 corresponds to 11. 11 is the fractionated phase of 7.

Q. Well, which film is this for, the fractionated phase or the unfractionated phase?

A. All these films are fractionated.

Q. So that this corresponds to number 7, and not to number 11?

A. Yes.

By Mr. Whitcomb:

Q. Referring now to the patents in suit, will you please look at those charts produced, Plaintiffs' Exhibits 14, 15 and 16, and state what they show, in your opinion?

A. These charts show a rotating drum, steel drum, in which are contained lead pieces or lead balls, a hopper, which admits these pieces into the interior of the drum, which rotates, a provision for providing a current or gust or blast of air through this drum, and a suitable method for collecting a fine powder which has been removed by the air.

Q. Why do you use the word "gust" or "blast" of air?

A. Those terms are specifically used in the patents in suit.

Q. And what do they indicate to you in this art?

A. Well, they indicate to me a very positive current, moving current of air, moving with considerable rapidity under possibly a pressure difference, supplying a continuous supply of air.

Q. From that description and the other material given in the patent with respect to the size of the drum, and so forth, would you be able to have a mill constructed, in your opinion, that would operate?

A. I see no reason why it would not be possible from the disclosures to construct an apparatus which would successfully produce a product.

Q. If you had sufficient air to blow material out of the drum what would that show you as an engineer in this industry with respect to the amount of air for oxidation purposes as required by these patents in suit?

A. That would indicate, of course, that there would be—concentration of oxygen was always in excess, and that there was available plenty of gaseous oxygen for oxidation purposes.

Q. Will you please then go on where I interrupted you about what this apparatus shows?

A. Well, it simply shows on this side here a dust collector, standard design for collecting the product, which is removed from the mill by the gust or blast of air.

Q. The chart you are looking at is the one for the 150 patent, is that right?

A. Yes.

Q. Will you please now refer to the 150 patent, particularly page 2, beginning at line 39, to the semicolon, where it says: "It is easy to maintain the harmony of oxidation of the surface of the material lead, and abrasion of oxidized lead."

Will you please now explain to the Court what this signifies to you, having described broadly the apparatus and features of the patent?

A. This combination it seems to me presents one of the most interesting chemical systems that is possible to imagine, and I—I would have clearly in

mind, it seems to me, that the following things are happening, and we are concerned with the following rates of the processes and the reactions.

First of all we have, we must have absorption before anything can happen, absorption of gaseous oxygen upon the surface, metallic surface, a fact, of course, which is well-known in chemistry, so that the rate of absorption under the conditions of air, the partial pressure of oxygen, temperature of the solid surface, temperature of the air, is, of course, a definite thing, although it is a variable which is controlled by these various factors.

The second rate which we might think of is this. It is well-known, of course, that gaseous absorbed films are conditioned particularly on catalysts by—their thickness, and so on—by the rate of a blast of gas passing over the surface.

Q. Pardon me, by the way, have you got a showing of the lattice structure of these materials?

A. I have.

Q. Will you produce that? We might want to use that.

(The witness produced an exhibit.)

By Mr. Whitcomb:

Q. Now, what does this represent?

A. That represents a photograph of three models. The first on the left is the model, well-known, of metallic lead, the face centered cubic lattice, in which these balls represent atoms.

The middle model, the central model, represents the structure, cubic structure, of cuprous oxide, silver oxide and lead suboxide, a cubic structure in which the metal atoms are still upon a face centered cubic lattice.

The third one on the right-hand side is a model of the crystal structure of tetragonal lead monoxide, or litharge.

These are derived, of course, from the crystal structure analysis.

Q. Are these well recognized methods of—

A. These are standard—

Q. — picturing—

A. Standard models, well-known in all X-Ray laboratories, of representing results of crystal structure analysis.

MR. WHITCOMB: Counsel for the plaintiff offers in evidence the lattice structure pictures produced by the witness, and asks the Clerk to mark same Plaintiffs' Exhibit number 29.

(Lattice structure pictures produced by the witness Clark were marked Plaintiffs' Exhibit number 29.)

By MR. WHITCOMB:

Q. When you were speaking about the absorption a moment ago can you illustrate anything in connection with these pictures of the latticework?

A. Yes, we will come to those in just a moment. The absorption so far is a purely physical phenomenon, in which we have a layer of absorbed gas as a gaseous film on the surface of the metal. In this process we have, first of all, an absorption process, and the rate thereof, the variables introduced in the thickness of that film by blast of the current of air.

Now, the third rate with which we are concerned is the rate of chemical combination of oxygen in the absorbed gas film with the metallic lead surface, and if we may assume for the—we may assume this process, for the moment, the lead atoms, or the oxygen

atoms in the absorbed film at first are held by forces which we class as physical, but under the conditions of reaction, particularly at the elevated temperatures, a chemical reaction can take place, in which oxygen atoms will enter; they have a considerable mobility, they may enter the latticework, the crystal latticework of the solid phase, namely, metallic lead.

Now, if we will observe on this model of the so-called cupric model, cuprous oxide, or silver oxide, or the lead suboxide, as we have identified it, its spectrum corresponding to the two known ones, it is perfectly reasonable from the standpoint of crystal dynamics that the lead lattice shall maintain itself just as long as possible, metallic lead, even upon the entrance of oxygen into, between the planes and among the lead atoms, and this central model shows that very thing, namely, that the lead atoms are still—or the copper atoms, the silver atoms are still maintaining their characteristic face centered cubic lattice, but that oxygen has entered, has moved the metallic atoms, slightly, of course, that is, the distance apart is somewhat changed, the oxygens take up perfectly definite positions in the space, and in the ratio of two metal atoms to one oxygen atom, thus producing, as I say, the well-known cupric or silver oxide structure, in which there is no disruption, no discontinuity, no sharp jumping around of atoms, or anything of that sort. That seems to me to be a third process which is taking place there, a rate of reaction, the oxidation, the beginning of oxidation of metallic lead to the state where the oxygen will enter the latticework of metallic lead under the conditions thus considered.

By The Court:

Q. What is the film before the entry of the oxygen atoms?

A. Well, of course, that is—the film will be oxygen and nitrogen, that is, any—any constituents of the atmospheric air. Possibly, that is a thing, perhaps, we don't know very well, possibly the oxygen is preferentially absorbed upon the metallic surface.

Q. Now, but, now, you have got to make it a little clearer to me.

A. In the air—

Q. First you start with these lead balls.

A. Yes, in the air, of course.

Q. When you speak of these pieces, and then something happens by which there is a film formed on the surface of those lead balls, that is the film you are speaking of?

A. Yes.

Q. Now, that film consists of lead and something else?

A. Yes.

Q. Or am I right about that?

A. That is right, the very first thing that happens is a gas, the gas, molecules of oxygen are taken out of the gas and attach themselves on as an absorbed film, just as if we would—

Q. Well, then, the film you are speaking of is entirely composed of gas molecules?

A. Yes, in the first,—

Q. All right.

A. — the very first process.

Q. That is what I mean.

A. Yes.

Q. Then the second step, or the second rate you speak of is the question of how intensely you oxidize. and has to do largely with the extent of the film, doesn't it?

A. Yes.

Q. More than anything else?

A. That is right.

Q. Well, then, the third step you have come to now is the entry of oxygen atoms into something, into the lead?

A. Into the metallic lead, that is right.

Q. That is, from the film?

A. From the film.

Q. Not from the outside into the film, but from the film into the metallic lead?

A. Because those are the attached oxygen molecules.

Q. Now, if I am wrong about my idea of this just stop me and tell me so; that is your idea, now?

A. Yes.

Q. I have stated it correctly?

A. That is correct.

Q. All right.

A. So that in—in this stage of which we are now speaking, right on the surface of the lead, penetrating down into the lead, we have oxygen atoms in definite arrangement. Thus we have a new compound, new crystal form, it gives a different crystal pattern, if we examine the surface of the balls, and so forth.

Q. Well, why do you assume the existence of a film rather than direct penetration by the air?

A. You can assume the existence of a gas film—

Q. Yes.

A. — to begin with.

Q. Yes.

A. Of course, in a solid-gaseous reaction, by, I suppose, thousands of papers on the subject always indicate that before reaction can take place between a static solid surface and a gaseous phase that the gas is first absorbed more or less by physical proc-

esses, physical attractive forces, and then, of course, there is a twilight zone, a very decided twilight—

Q. You mean it is simply a heavier concentration of gas—

A. Yes.

Q. — at the surface—

A. Yes.

Q. — of the solid?

A. That is it.

Q. All right.

A. That goes over, then,—

Q. I understand.

A. — into chemical combination.

Q. Yes.

A. So, then, we have the rate of superficial oxidation of lead.

Another rate, then, after a layer of this has been formed, of course, oxygen is being continually supplied from the atmosphere, and in the gaseous film, and at the given temperature it is entirely conceivable and is a matter of fact that as more oxygen is added this lead lattice, which has tried its best to maintain itself, if no longer stable, it will no longer hold any more oxygen and there is a rearrangement into the well-known and definite crystal form of PbO, litharge, so we have then the rate of oxidation, let us say, of Pb_2O, this incipient stage of oxidation, to PbO.

By Mr. Whitcomb:

Q. Do I understand you to say that the lead itself, however, would rather maintain its first condition, is that your thought?

A. As long as it can, yes, as long as it can.

Q. When it can't do that any more then what happens?

A. Then as more oxygen is added, that is, in the ratio of one atom to one atom, or one molecular

weight to one molecular weight, this central configuration in this diagram is no longer stable, and there is formed the latticework on the right-hand side which is characteristic of litharge.

Now, another rate with which we are concerned then is the rate of diffusion of oxygen through the outside, protecting, oxidized layer into the interior of the ball or piece of lead, because that is a very decided factor, the rate of diffusion of further oxidizing air or oxygen through the protecting or saturated outer layer. That comes into the picture.

By The Court:

Q. Now, would all this happen if there wasn't any friction or abrasion of the lead surface?

A. All of that is concerned, yes.

Q. What?

A. I say all of this will take place, especially this last process.

Q. Would it take place without any abrasion, in case these balls were just stationary or static,—

A. Yes.

Q. —and you blew air on them, would this same thing occur that you are speaking of?

A. They establish an outer layer.

Q. All right.

A. That would become higher oxidized. Then the penetration, of course, would be very, very slow, because of the protecting outer layer, it would all depend on how fast chemically and physically atmospheric air can penetrate through a saturated outer layer into the unchanged metallic lead on the interior.

Q. All right.

A. Then the next rate with which we are con-

cerned is, of course, the rate of removal by abrasion of this outer, oxidized layer.

By Mr. Whitcomb:

Q. That is the mechanical action, is that right?

A. That is the mechanical action introduced by the tumbling.

Q. Upon what does that depend?

A. That depends, of course, in this process by the rubbing or abrading of lead pieces or lead balls rubbing against each other, hitting each other, and rubbing on each other.

Q. Does the speed have something to do with that, of rotation?

A. The rate of abrasion, in other words, the actual rate of abrasion in one of these many factors involved will, of course, depend upon the rate of the charge, that is, the amount of material present, the size of the individual pieces or balls, the rate at which the rotation takes place, but the process goes on, it is just merely the details as to the rate of abrasion which is determined by these variants.

Q. Well, then, in the process involved in this suit, such as disclosed in this patent, when you arrive at the third form of latticework shown on the exhibit what happens to the lead suboxide then, in your opinion?

A. We know that the exterior of any lead piece which has been exposed continuously to an excess of oxygen consists largely, very largely, of PbO, tetragonal lead oxide. In our examination of successive layers, however, of such a ball whose very outer layer was lead monoxide, we find increasing concentrations and evidences of lead suboxide. In fact, we find evidences of lead suboxide right down, in intimate contact with the apparently unchanged metallic lead,

metallic lead serving to stabilize it. Consequently it is evident that the outer completely oxidized layer, PbO, forms a protective layer, which has not yet permitted enough oxygen to penetrate, or, perhaps, the temperature conditions to be such that all of the suboxide on the interior, underneath this and in contact with the metal, shall have all been transformed into the saturated PbO.

Thus we find increasing concentration down underneath.

Q. Now, then, in this process your opinion is that the lead is oxidized and passes through the formation of the Pb_2O and forms also PbO, is that right?

A. Yes, on the outside, in contact with excess air, PbO is produced.

Q. Does the Pb_2O, the suboxide, form anything else?

A. In the presence of, or at the elevated temperatures of this very curious unstable substance, by reference to all of our experiments, including the lead oxalate experiments, positively we know dissociates or breaks down into lead and lead oxide, simply because at an elevated temperature, and by reason of the rather large size of the lead atoms as compared, say, with copper or silver, this material prefers to, in the presence of not enough oxygen to form itself, to split itself into the two stable materials, Pb PbO.

Q. You mentioned the size of the particles you found. Does that show you anything in these tests you made of these products?

A. It shows, of course, that the particle size is extremely minute. If we take the lead oxalate experiment, in which there is no grinding, no grinding whatsoever, lead oxalate; we don't grind it at all, start with a powder, or crystal, anything we want to, single crystal, if you wish, decomposes it in a vacuum, with

heat, there is produced there, not by any grinding process at all, by no abrading process or anything of the kind, a very, very fine molecularly subdivided product of lead and of lead monoxide, of course, some lead suboxide also, so that the fineness, we have every reason to believe that the fineness of lead and of lead oxide, and especially of lead suboxide that we find in such a process as this reasonably has been produced, and that the very fine phase crystals, particle size, has been produced by some molecular process, rather than by some mechanical process, it is a general feeling among colloid chemists, based upon experiment, that you cannot grind anything very much any smaller than, let us say, about ten to the minute fourth power centimeters, whereas—

Q. What do you mean by that, ten to the minus fourth?

A. Well, that is .0001 centimeters, one ten-thousandth of a centimeter, whereas in the case of the X-Ray examination of these materials we know that we are dealing with primary crystalline particles which are distinctly in the colloidal range of ten to the minus sixth power.

Q. That is way below any possible size of particle you could get by grinding?

A. Exactly.

Q. I wonder, did you refer to the, in speaking of the various rates, the rate of the oxidation from the PbO to the PbO? I believe you did.

A. Pb_2O to PbO. Of course, then, there is this rate. A further rate we haven't mentioned is the rate of dissociation of lead suboxide into Pb plus PbO, under the proper conditions. Now, the question is why, why can't we have, why isn't there formed a large amount of Pb_2O, why doesn't it stay there? Because it dissociates, and because the whole tend-

ency is in the dissociation form; in the first instance, we can think of an atom of lead, atomic lead, exceedingly fine divided, exceedingly active. The instant that lead is formed, instead of recombining with lead oxide, Pb plus PbO, to give us Pb_2O, this extremely active lead might do one of two things, it might be oxidized again, thus removing it from equilibrium—

THE COURT: I think I will ask you to suspend just a moment.

(Interruption.)

THE COURT: All right.

THE WITNESS: I wish I had a blackboard, I could show these things perhaps more clearly.

THE COURT: We haven't anything like that, have we? We haven't got any blackboards, have we? I don't believe we have.

MR. MORRIS: We have here the equivalent of it, some heavy crayons and paper that you can use.

THE COURT: All right, if you have something there.

By MR. WHITCOMB:

Q. Would you like to show something?

A. I think I can show some of this a little more clearly by writing some of these formulas down.

(Discussion off the record.)

THE COURT: I really don't think this demonstration is worth while going into the record, because it won't mean a thing when you get it written.

MR. WHITCOMB: That is the objection I have to a temporary thing like this.

MR. MORRIS: What is that?

THE COURT: I say it is hardly worth while for the stenographer to take down what he says during this demonstration, because it won't mean anything when you come to read it.

THE WITNESS: I will simply say in words at the same time I am writing—

MR. MORRIS: It might in connection with what he does,—

THE COURT: All right.

MR. MORRIS: — because that might be an exhibit, if it is worth anything.

THE COURT: All right, now, you go ahead anyway you want that will make it clear to me.

THE WITNESS: I am just speaking of this dissociation here between three solid compounds, here is the lead suboxide, Pb_2O, dissociating into lead plus PbO. Now, why don't we have a whole lot of lead suboxide, enormous quantity of it, for example? Of course, the most we have ever formed by heat process has been about twenty-nine per cent. The point is simply this, if one molecule of this, just one single molecule—

THE COURT: Now, try and avoid "this" and "that", if you want your record to mean anything.

THE WITNESS: All right, one molecule of suboxide of lead.

THE COURT: Those words are fatal words when you come to read a record.

THE WITNESS: If one molecule of lead suboxide can be considered to suddenly break apart into one lead atom and one PbO, the reverse process, of course, would be, in order to form lead suboxide, would be for lead to combine with lead oxide, in other words, a reversible process, or equilibrium set up. However, if we remove from this side, from the lead and lead oxide side of this equation, one of the constituents in any way, or change it in anyway, then the reaction of dissociation must proceed away from lead suboxide, it must be in favor, favorable to the dissociation and decomposition of Pb_2O.

Lead can be removed either by attaching itself on to oxygen, to form lead oxide, or lead suboxide, more lead suboxide, or under certain conditions, at high temperatures, those lead particles can be conceived to grow, instead of now being very finely divided and very active, and entering into this equilibrium, those lead atoms may get together and form a little crystal, and thus may actually grow into little balls of lead, no longer active, the active mass of lead is no longer involved in this, those little tiny globules of metallic lead that you see under a microscope, is that process takes place, this annealing process, or grain growing process takes place, it is all favorable to the dissociation of this unstable compound, Pb_2O, just as favorable to its dissociation as if we were taking those lead atoms out with a tweezer, or something of that kind, so that the net result, of course, is that we find only very small quantities, relatively small

quantities of suboxide of lead under the ordinary conditions of operation of these mills, and also under the conditions of dissociation of lead oxide, we produce it in pure form, or essentially pure form, or very nearly pure form only by taking this mixture at low temperatures, and separating it by the super centrifuge.

MR. WHITCOMB: Counsel for plaintiff offers in evidence the sheet used by the witness in this demonstrated talk, and asks the Clerk to mark the same Plaintiffs' Exhibit 30.

THE COURT: Can't we make a smaller exhibit out of it? It isn't very much.

MR. WHITCOMB: It will have to fit in, I imagine.

MR. MORRIS: Can it not be reproduced now by the witness on a smal. sheet?

THE WITNESS: Yes.

THE COURT: You go ahead and write it on this piece of paper, if you really want to keep it, reduce it to boy size.

(The witness copied the formula on to another sheet of paper, which was marked Plaintiffs' Exhibit 30.)

By MR. WHITCOMB:

Q. Now, then, to summarize these rates of actions going on will you please list them? I believe you had a list of eight, or some odd number.

A. There are several rates of reaction going on, one, rate of absorption of gaseous oxygen on lead surfaces; two, rate of removal of absorbed layer by air currents; three—

Q. Now, then, number two, did you refer to that before?

A. Yes, the third I didn't, I think three. The rate of cooling by the air blast.

Q. Please elaborate on that a moment.

A. We have at first—

THE COURT: You sort of covered those two in the second stage—

THE WITNESS: Yes.

THE COURT: — that you were talking about before.

THE WITNESS: Yes, that is right. The heat is being evolved, of course, in the oxidation process, one mole of PbO is accompanied by fifty thousand calories, approximately, approximately fifty thousand calories of heat, and obviously all of these rates are going to be conditioned, determined in part by the actual temperature condition. Now, the air going in as a blast obviously has an effect upon temperature of these surfaces of the lead, and so on, the unchanged lead ball, so that simple rate is one of the essential features, the rate of the, actual rate of cooling of the mass and of the surfaces by the air blast as it passes over and through and around the various particles during the operation.

By MR. WHITCOMB:

Q. Does that prevent the temperature from rising too high?

A. It would tend to do that, yes.

Four, the rate of oxidation of metallic lead at a given temperature. That, of course, means the superficial oxidation to suboxide.

Fifth, the rate of diffusion of oxygen through the oxidized layer.

Sixth, the rate of removal of the protecting layer by the mech ical abrading action, depending on the size of the balls, the rate of rotation of the drum, the amount of charge, temperature, and so on.

Seventh, the rate of dissociation of lead suboxide, Pb_2O, to lead plus PbO.

And eighth—

Q. Does that involve this equilibrium theory—

A. It does.

Q. — you have just discussed?

A. It does; and eighth, the rate of oxidation of Pb_2O to PbO, tetragonal.

Now, do you want to refer to the original question? Is that what you want me to do now?

Q. Yes, now, you remember we started this discussion by reference to the patent 150, and please state now, does this apply to that disclosure, as you understand it?

A. It is easy to maintain harmony of oxidation of the surface of the material, lead, and abrasion of oxidized lead. It seems to me that the word harmony is an exceptionally cogent and excellent method of describing the complex types of things that are going on, these parallel and subsequent reactions, one after the other, going on together, all of these things working together or against each other, and in order to—since there are at least eight of these, all different rates, it follows that any satisfactory process must represent a harmony of these various things in order to produce satisfactory results.

Q. By the way, I forgot to make the standard inquiry as to whether or not you have studied all these patents in suit in detail and are familiar with them. I assume you are?

A. I am.

Q. Now, will you please refer to the subject matter set up in the claims of the 150 patent, and state whether or not, for example, some of these claims, 1, 2, 3, 4 and so forth, specify this combination of processes going on as you have described it.

THE COURT: Now, what patent are you going to take up?

MR. WHITCOMB: 150, I started with.

THE COURT: All right.

MR. WHITCOMB: Take claim 1, for example.

THE WITNESS: "A process of manufacturing a fine powder of lead suboxide intermingled with powder of metallic lead, comprising in putting pieces of metallic lead in a rotatable vessel in a dry state, introducing into the said vessel currents of an oxidizing gas to oxidize the surface of the lead while rotating the said vessel, and abrading off the oxide formed on the surface."

It seems to me that fits into this description which I have given. We recognize that in the final product clear, outside of the mill, that there is only a small proportion of lead suboxide, because, by virtue of the dissociation of lead suboxide into metallic lead and PbO, but if we take into consideration the fundamental mechanism going on within the mill I should say that this describes that process.

By MR. WHITCOMB:

Q. Refer to a claim such as claim six, for example.

A. "A process of manufacturing a fine powder of lead suboxide intermingled with powder of metallic lead, comprising in putting in a rotatable vessel pieces of metallic lead, introducing air thereinto and rotating the vessel maintaining the temperature of the material at not less than 60° C. by the heat generated by friction and chemical reaction."

I would say the same thing precisely about that claim.

Q. Do you find that the normal operation of a process of this kind does raise the temperature up to a minimum at least of that sixty degrees specified in that claim?

A. It does.

Q. Sixty degrees C. is what in Fahrenheit, about?

A. Let's see—104, is that right?

Q. 140?

A. Yes, 140, that is right.

Q. Now, refer to claim 8 of this 150 patent and state the same thing.

A. "In the production of a finely divided mixture of lead suboxide and metallic lead, the step of tumbling together and agitating, a mass of hard heavy material containing metallic lead, while maintained at a temperature between about 60° C. and about 200° C."

That presents a range of temperatures through which this process can—a whole range over which such a process can be expected to operate. These various rates of the eight different kind of rates are, of course, differently affected by the temperatures, by the temperatures of the reaction, by the amount of cooling, and so forth, and within those ranges, of course, the product will simply have a different proportion of oxidized material.

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Q. Now, as to claim 9 what do you find, and will you state the same thing with respect to it?

A. "A method of forming a finely divided powder containing a large proportion of oxidized lead which comprises impinging a current of air on lead masses in a dry state, abrading the lead masses, and controlling the temperature to obtain a finely divided powder containing a large proportion of oxidized lead."

That is, it seems to me, the best statement we have.

Q. Does that bring out this dissociation theory that you have advanced?

A. I feel that it does. It speaks of a large proportion of oxidized lead. Of course, there is no specific mention of the—of what kind of oxidized, or degree of oxidation. That we know.

Q. It does not limit it to the suboxide?

A. It does not.

Q. In your opinion what proportion of the material made in this process goes through the suboxide stage?

A. Of course, an exact estimate of that is exceedingly difficult, but I should say that, judging by the distribution of particles sizes, activities, and so forth, that initially—that a very large proportion of the change was gone through that stage of suboxide. We have indicated the different types of lattices. How rational it is that oxygen should first combine itself with lead, as we have indicated for the cubic Pb_2O lattice; but the conditions of temperature and rate of abrasion, and so forth, even though ninety per cent. or so should go through that stage, of course, that does not necessarily mean that there should be ninety or a hundred per cent. of lead suboxide in the final product.

Q. I notice in some of these claims, such as one and four, and nine, several references made to the fact that the masses are in a dry state. Please state what function that has in this process.

A. The whole process, of course, is a dry process, in which water is not involved, because if we did have water the probabilities are that we would have an entirely different course of reaction, mechanism.

Q. Then you regard that requirement as an essential feature, as a fundamental item involved in the processes?

A. Yes, although that does not—I do not mean to say that the presence of humidity, presence of water vapor in the air would in anyway vitiate the results or give you any essentially different end product, provided that that humidity was kept within reasonable limits.

Q. Will you now please refer to the 149 patent? I notice the title of this patent is "Method of Manufacturing Metal Powder", and bearing in mind what you have already described as to the process of 150 patent, state to the Court your understanding of the 149 patent, using this large exhibit chart which has been produced as Plaintiffs' Exhibit number 13.

A. I feel myself that when we speak of lead powder in this particular patent that it in no way means that we have a different process, that we have formed metallic lead to the exclusion of anything else, that no oxidation is taking place, or that such a process could proceed by a method or mechanism different from what we have indicated for the 150 patent. It is entirely possible by the proper control to obtain a product which is very high in very, very finely divided lead, pyrophoric lead, as a matter of fact, by pyrophoric lead we mean a product containing sufficient metallic lead in sufficient quantity that it will

spontaneously ignite upon access to oxygen, and consequently the generic term "lead" used here simply, it seems to me, refers to a product which has gone through the same fundamental oxidation process, but which may have or may not have a large proportion of metallic lead.

Q. In your opinion how is the metal lead powder produced in the process shown in the patent 149?

A. In the first place, metallic lead is formed by the dissociation of lead suboxide.

Q. As you have just described?

A. As I have described it. It is entirely conceivable, of course, that in the detaching of a thin, a very brittle, oxidized layer, that small particles of lead would also be disengaged, particularly as they cast, from cast pieces, where the crystal grains are quite evident. I do not believe that the oxidation process precludes the possibility of producing lead by breaking it off or chipping it off.

THE COURT: Are you addressing yourself to the fact that the claims of 149 refer to lead powder, is that what—

MR. WHITCOMB: Yes.

THE COURT: In other words, you are meeting the possible argument that the means just your lead powder, is that—

MR. WHITCOMB: Yes.

THE COURT: Is that the point?

MR. WHITCOMB: The claims, of course,—

THE COURT: Well, you say, of course, it means any oxide of lead, as well as lead.

MR. WHITCOMB: We say the patent means

the lead, but the process going on may incorporate these other features of the 150 patent.

THE COURT: You don't think that a lead powder, the word "lead powder" can properly describe an oxide of lead powder?

MR. WHITCOMB: No, that is it, and further, we are not contending that it may not include the oxides as well.

THE COURT: Yes; oh, I don't know.

By MR. WHITCOMB:

Q. In connection with the formation of a lead powder did you hear Mr. Ishimura's reference to the treatment of lead balls in a CO_2 gas?

A. I did.

Q. Do you agree with the results that he indicated as obtained in that method?

A. I do. We have conducted independent experiments, both in vacuum, in nitrogen, and in CO_2, in an effort to produce a large quantity of pure metallic lead, very finely divided, and these were done with ball mills, rather rough experiments, it is perfectly true, but in general I would agree with the contention and with the experiment, that an oxidizing atmosphere is essential to the production of a powder in any quantities at all.

By MR. MORRIS:

Q. At any temperature, Doctor?

A. Well, of course, what Mr. Ishimura had was at room temperature. We made some rough experiments at elevated temperature, say at 212 degrees Fahrenheit, and using—using balls in an ordinary ball mill, not reproducing a mill, a mill like this at all, we have no such opportunity: that is, even at elevated temperatures, that is, in inert atmosphere, in vacuum,

that works best, or nitrogen, or CO_2, the balls just tended to polish each other.

By Mr. Whitcomb:

Q. Will you now just briefly refer to claim 1 of the 149 patent and state whether or not you find in these processes that a finely divided chemically reactive lead powder of such fineness and activity as to be readily changed chemically on contact with air is produced.

A. It is produced. I have observed samples of material prepared in Japan, which is extremely chemically reactive, under the condition in which the particular powder was made, in the sense that it particularly when slightly moist oxidized, changed color in air very, very rapidly.

Q. I assume from your previous discussion that the other recitations of claim 1 with respect to the introducing of the lead and rotating the vessel and the attrition also takes place, is that right?

A. Yes.

Q. Will you please next refer to the 151 patent, and plaintiffs' chart exhibit P-15, and state the same thing with respect to the substance of this patent?

A. This patent and apparatus and machinery provides for exactly the same mechanism which we have been discussing, rotation of balls, the production of a current of air, oxidizing air going into the drum, and the formation of a powder containing lead, lead oxide.

Q. Will you please refer to the claims of the 151 patent and state what is brought out in this patent particularly?

A. "The process of forming finely divided oxygenated lead compounds which comprises treating a finely divided chemically reactive powder comprising a major portion of lead suboxide with an oxidizing substance."

That is precisely what I have been indicating all the time, namely, that lead suboxide easily oxidizes to PbO. Of course, it is conceivable if we went to very high temperatures we might have other oxide, but under this range of temperature we have the tetragonal form of lead oxide, and experiment indicates that this finely divided oxygenated lead compounds, it is possible in these mills, just as it is with the powder, the black powder formed from lead oxalate, to expose to oxygen or oxidizing agents and to end up with precisely the same result as regards the quantity of PbO, the quantity of lead, in fact, you can produce a hundred per cent PbO under the proper conditions.

Q. I notice that claim 2 of the 151 patent includes the requirement "maintaining the reaction by the evolved heat of reaction". Have you found that present in these processes?

A. Yes, yes, that is what carries the reaction on, all these reactions, with sufficient rapidity so the product is formed in a reasonable length of time.

Q. And as I understand your testimony to be, this going on in the mill and practically cannot be stopped, is that right?

A. Absolutely not, this fine powder which has been abraded off is surrounded with a large excess of oxygen all the time, with air, it is being carried by air out, in fact, in this particular modification, and the conditions are absolutely perfect that the reaction should keep on going on until the material is chilled down or made cold, so that it stops.

Q. All right, will you now, then, refer briefly; now, at least, to the patent on the plates, 1,584,479, and state in the record your opinion of the essence of the disclosure of this patent?

A. The first claim, preparing plates for storage batteries, reducing metallic lead to a fine powder, ex-

posing the powder to the air, which, of course, produces the oxidation process of which you have been speaking, kneading the mixture into the form of a paste, and so on, and so on, the drying, drying same thereby to convert the lead suboxide into lead hydroxide—that is the process which is being used successfully in making storage battery plates.

Q. From what material?

A. From material taken from mills of this kind.

Q. Will you please refer to page 1 of this patent, particularly in the reference to the counteracting of the shrinkage, in lines 40 and 41, and state your opinion of that action?

A. I think that that is essentially correct, from the [illegible] from any knowledge that we have of any experiments which we have performed. The presence in the powder of an exceedingly finely divided phase, solid phase, is very advantageous in this particular. I would, under lead hydroxide, of course, I would want to include also such compounds as 3PbO, 1H20 and other basic hydrated oxides, I think that the lead hydroxide could be construed to include any of these known, definite compounds.

Q. Now, will you please turn to the drawing of the defendant's plant as submitted in the report by Dr. Wilson, Exhibit 20, and explain to the Court how in your opinion the apparatus and the operation thereof comes within the essence of these patents, as you have been discussing them today, particularly starting, say, with the 150 patent?

A. As I understand it, we have a vessel, a rotating vessel, into which is placed a series or a combination or mass of balls, this mill being caused to rotate, and a current of air passed through the mill, at the same time, as an oxidizing medium. The product formed by the processes of oxidation of the surface of the lead balls was examined by X-rays, microscopically,

THE COURT: Where is the fan?

MR. WHITCOMB: Why, up at the end, here, sucks it through.

THE COURT: Oh, this is a suction arrangement, not a blower.

MR. WHITCOMB: No.

THE COURT: All right.

MR. WHITCOMB: The patent says it can be a suction, too.

THE COURT: All right, go ahead.

THE WITNESS: The atmosphere, the air, atmospheric air and oxygen reacting, oxidizing the surface of the lead balls, which are being tumbled or rotated in this mill, maintained at an elevated temperature, the product is then received through suitable screens, and so forth, into collectors.

The essential features, it seems to me, are the bringing together in a rotating mill lead balls or lead pieces in an atmosphere of oxygen, causing to ensue the various reactions which we have been discussing, the abrading action taking place by the rubbing of these balls one upon the other, and the collection of a product consisting of lead monoxide, metallic lead, and small quantities of lead suboxide.

By MR. WHITCOMB:

Q. What about the amounts of lead suboxide in the drum itself, in your opinion?

A. I think that the lead—the process of oxidation and abrasion of those lead balls is going through a lead suboxide stage practically completely, just as we have indicated before.

Q. In connection with the patents in suit?

A. Yes.

Q. What have you to say about those eight, I believe it was, rates of harmonizing—

A. Those proceed—

Q. Harmonizing reactions.

A. Those proceed just the same, that is, all are involved in this reaction in just the same way, there is no feature to eliminate any one of this combination. Of course, this gives the conditions, the final product, as far as the constitution of the various components.

Q. I notice that this is, the drum itself is entitled Hardinge mill; what have you to say of that as compared with the cylindrical mill shown by the patents in suit?

A. Well, to me the essential features, irrespective of the size or shape of the outside of the cylinder, whether it has a double cone, or a straight cylinder, is that of exposing in an oxygen atmosphere metallic lead surfaces, and abrading those off by rotating, abrading process.

Q. But actually the Hardinge mill has what function, if anything, different from the cylinder, does it add to this?

A. The theory of this double cone, of course, is that there is a certain degree of mechanical action involved, partly centrifugal, in which there is a classification of powder.

Q. Would this process operate if you shut off the air, in your opinion?

A. I do not believe that a satisfactory process would operate in the absence of air.

By The Court:

Q. Well, you couldn't get the powder out if you didn't have air, could you? How would you get the powder out of the mill at all?

A. Well, I don't see how you could, either.

By Mr. Whitcomb:

Q. Of course, what is the function of the inclined plane, as far as the powder getting out is concerned?

A. Well, the theory of the Hardinge mill, of course, is that there is a certain mechanical creeping action which throws out the—

By The Court:

Q. Well, it would just dribble out, but there wouldn't be any separation into the finer—it would all come out ultimately, wouldn't it?

A. Well, it would, of course, if it were tilted enough.

Q. But it would not be a very satisfactory operation without the air?

A. No, I shouldn't think so.

The Court: Well, I think we will recess for ten minutes.

(Recess at 3.25 o'clock P. M.)

After Recess.

George L. Clark, recalled.

Direct-examination (continued).

By Mr. Whitcomb:

Q. Will you please refer to Dr. Wilson's report on the beginning of the part entitled Section 3? It is on page 5 of the report: pages 9 and 10 of the type-

written report; and state what you find that are the actual figures for the change in the test described where the material was left to stand twenty-four hours, and analysis showed 94.65 per cent lead which was previously found to contain 95.48 per cent lead, and explain in detail your method as you go along, if you please?

A. Dr. Wilson has calculated from the percentages correctly. That is the final product we have 36.9 per cent metallic lead calculated as metallic lead, and 63.1 per cent calculated as lead oxide. Did you want a calculation on the next page, that is an explanation in which there has been an increase in weight?

THE COURT: He let that stand, he says, for twenty-four hours; then he found it contained 94 less lead.

MR. WHITCOMB: Therefore, what?

THE COURT: He says the change would indicate oxidation of some metallic lead.

By MR. WHITCOMB:

Q. We will try to figure that out, Dr. Clark; you can give the figures on that?

A. Oh, yes.

THE COURT: Where does all that tie in with Dr. Clark's theory of lead sub-oxide?

THE WITNESS: Your Honor, this is, of course, a straight chemical analysis made by ordinary methods of quantitative analysis in which the results have been calculated Pb and PbO.

By THE COURT:

Q. In other words, 94 and 65 per cent lead does not necessarily mean all pure metallic lead?

A. No, it doesn't necessarily mean all pure PbO; that may not include lead as lead sub-oxide, also. You see, the actual quantity in this analysis, the actual proportion of lead sub-oxide is unknown, and the chemical analysis of this type would not differentiate between lead sub-oxide and lead oxide; that is, with these available figures.

The change from 95.48 to 94.65 per cent of lead, while that seems to be a very small amount of lead, yet because—I mean a very small decrease in the lead content, is actually because of the high equivalent weight of lead quite appreciable. We can illustrate that most easily in this next experiment down here. For example, we take a powder 8.1321 grams.

Q. He said exactly what you said: the high weight of lead should be taken into consideration.

A. Yes, the middle paragraph on page five of the printed record we have this experiment, 7.216 showed increase of .0778. Now, if we take those figures, the .0778 must represent all oxygen, an increased weight of oxygen. We have 63.1 lead oxide, and 36.9 of lead in those 7.216 grams, it will give us in the sample 2.665 grams of lead in his sample; that is, in this sample of 7.216.

Now, .0778 grams of oxygen are combined with just about one gram of lead to produce lead oxide, PbO, and we will, therefore, have 1.665 grams of lead left in the product after oxidation, which is twenty-two per cent of lead still present. In other words, in that fine in the increased weight, the lead has increased from 7.9 to 22 per cent, a change, you see, of about 15 per cent in the total percentage of lead, all of which indicates that a powder of this kind will undergo still greater oxidation when exposed to air; the lead will go over to lead oxide.

By Mr. Whitcomb:

Q. Will you explain to His Honor the one thing in connection with Claim 1 of the 49 patent which uses the term chemical active powder, when it comes in contact with air? That is what we are explaining here. Take it from the other angle and consider that, and show what increase in percentage of PbO was obtained in Dr. Wilson's report when he let the sample stand for twenty-four hours?

A. The PbO content increased 63.1 per cent to 74.6 per cent in twenty-four hours.

Q. And increase of what percentage?

A. That is an over-all increase of 11½ per cent.

Q. Do you consider that a substance that readily changes when in contact with air, in view of those facts?

A. I would say that 11½ per cent is an appreciable amount, and represents the fact that this material is still reactive even though it may be covered over with PbO.

Q. In order to have the record complete, will you put in that formula you used to obtain that?

A. Yes. In the calculated form a given percentage of lead determined by chemical analysis, let X equal the fraction of free lead; then one minus X is the fraction PbO. We then take the proportions of atomic and molecular 20.72 for the atomic weight of lead divided by 223.2, which is the molecular weight of PbO, times one, minus X, plus X—that is, that is the fraction of lead in PbO—plus the fraction of lead, free lead, equals the percentage, and we calculate one minus X.

Q. And you got what figures?

A. This particular calculation I have made here is simply to confirm Dr. Wilson's original value, 36.1 per cent of lead, 63.1 per cent of PbO. We use the

same method to calculate the 74.6 per cent of PbO, which is formed after twenty-four hours.

Q. Now, will you please refer to the 150 patent, and this chart, Plaintiffs' Exhibit 14, and take the patent? I want to be sure you find the exact and particular foundation for each of the parts. Will your mind going right through it so we will have that in the record, why you say this drawing does represent the apparatus described in the specification, which contains no drawing?

THE COURT: I thought he did do that.

MR. WHITCOMB: I think he didn't.

By MR. WHITCOMB:

Q. For instance, this rotary feed, do you find anything like that?

A. Any condition, any device that you want, if I remember rightly, so that you supply lead pieces to the rotatable vessel.

Q. As to the other features, you feel you have already covered that?

A. I have already discussed that.

Q. In connection with the active of this material that you referred to and pointed out these changes, would you give some idea to the other product, the chemical materials that are produced; did they change that rapidly, a change of eleven per cent, say, in twenty-four hours' standing?

A. Well, in my mind there aren't very many substances which oxidize so readily. It is conceivable, and undoubtedly is true that exceedingly finely divided iron powder would oxidize to rust on exposure to air. Of course, we know that certain other very, very active materials like soft pure metals such as sodium, potassium and calcium, and so on which very easily oxidize. We can't keep them in air at all without oxi-

dation; they change very rapidly. Other substances, however, are the normal oxides, salts most of them are ordinarily quite stable. There are lots of organic and biologic materials which are not stable in air.

Q. Now, there are some general questions we would like to ask. For example, what have you to say about why there is any sub-oxide in the final product of defendant's mill, or plaintiffs' embodiment thereof, of the patent in suit if it goes through this dissociate theory that you have announced?

A. In the first place, we do say upon the basis of that equilibrium theory, we do set up an equilibrium which would enable us under given temperature conditions, that is, the room has an elevated temperature over a certain length of time, a certain proportion of one associated Pb_2O; then, also, Pb_2O is protected, oftentimes entirely coated over; it is protected, coated over, and thus preserved against it.

However, the microscopic examination demonstrates its actual presence there. I think these two other given equilibrium conditions, the given equilibrium under the two conditions, time and temperature, and the exposure over that time to air, to oxygen.

Q. In Plaintiffs' Exhibit 26, which is the chart illustrating the films that you have introduced by way of exact illustration, where and how much more, if that be the case, do you show that there is Pb_2O in the mill in the products examined as taken from the mill as compared with the end product finally obtained out of the mill?

A. That is best shown, of course, by these films, D5, which represent the layers under the outside coat on the ball, itself. There is the increased concentration there, and undoubtedly the material is stabilized by being in contact with the metallic lead and protected from further oxidation by the outside layer to PbO.

Q. That is the length of what line here?

A. The center line in all cases.

Q. You compare the length of this center line, say D52, with what on that chart to compare it with the percentage in the final product?

A. Compared with any center lines of any of these to the D1's, D3's, and so forth. This attached table gives the actual numerical values.

For example, on one sample, D1, the fine fraction after sifting, 7.3 per cent; course fraction, 4.8, and the ordinary unsifted product, 5.67. In all cases, the finer fraction from the mill after screening contains the largest proportion of the suboxides of lead. On the ball, D52, we find a maximum concentration of 14.6 lead suboxide in the protected layer underneath the exterior.

Q. I hope this isn't repetition, but I wondered if you explained fully why there was no chemical process for analyzing for Pb_2O in these products at the very outset?

A. Of course, Pb_2O has not been known in a pure form; it has never been isolated so that people could study those peculiar reactions.

Pb_2O undoubtedly has similar volubilities. When you go to try to separate lead from lead oxide, Pb_2O could be exposed to go into solution; you couldn't separate it by any differential volubility method. You can't get it away from PbO, and since you can't get it in a separate phase, of course, you can't analyze for it. If you could do that, then the only suitable method, the analysis would show you had lead and oxygen in it. You would then have to proceed to a molecular weight determination to show it was two items of lead to one of oxygen. For that reason it is so important to use these newer distinctive physical methods which distinguish it, its X-Ray picture, its appearance in the microscope, and so on.

By THE COURT:

Q. But you separate by your centrifuge, do you?

A. Yes.

Q. That separates it?

A. Yes.

Q. How long has that apparatus been in existence?

A. The centrifuge in its present form is a comparatively new apparatus; that is, the one that will operate at fifty thousand r. p. m. The Sharpless people make one now—that is, the cream separator people—and, of course, it has required the advent of these new very fine stainless steels in order to hold together fifty thousand r. p. m. It has to be constructed with extreme care. It is a comparatively small apparatus, but just the centrifuge part of it costs about a thousand dollars.

Q. How long has that been available for use?

A. So far as I know, in the last three or four years. The one we have is brand new.

By MR. WHITCOMB:

Q. Did you make any prior attempts to centrifuge this material?

A. We tried with ordinary methods; that is, with the ordinary centrifuge such as the chemist's laboratory has, but without any particular success.

Q. It was only how recently tested?

A. These tests were conducted in August, the latter part of July and August.

Q. Of this year?

A. Yes.

Q. With this expensive centrifuge machine?

A. Yes.

Q. Have you any photographs of your X-Ray machine?

A. This is an exact photograph of the apparatus

upon which all this X-Ray work has been done, and the camera may be seen at the back, a cylindrical camera used for the purpose of examining these.

Mr. Whitcomb: Counsel for the plaintiffs offers in evidence the photograph, and asks the Clerk to mark the same Plaintiffs' Exhibit No. 31.

By Mr. Whitcomb:

Q. What does the particle size of metallic lead in the final product indicate with respect to the sub-oxide in the mill?

A. We have indicated that already, namely, that the next to the finest fraction as we can separate into various fractions by the centrifuge, the next to the finest fraction is a fraction of nearly pure metallic lead. There is some little lead oxide in it. And that, of course, indicates that there is present a large amount, a large proportion of metallic lead, actually in a very finely divided stage.

There is also the very coarsest fraction thrown out; that is the first fraction that comes off, a coarse fraction of lead, little tiny pellets. The longer this material is kept at an elevated temperature the larger these particles of lead become, so that the presence of acid, finely divided lead would have a bearing, it seems to me, upon the validity of a molecular type of process in which a molecule is broken apart.

Q. When you were talking about this analysis reaction going on in the process 150 patent, is it your testimony that in your opinion that was involved in an invention?

A. Yes.

Q. And you have talked about your understanding of the operation of defendant's mill both from the drawing and from Dr. Wilson's report; is it your opinion that their operation involves the process incorporated in this invention?

A. I can't see any distinction whatsoever so far as fundamental process of the mechanisms is concerned. The analysis of the materials from the Shimadzu's mill such as is obtained from the mill operating in Indianapolis, and the Exide material as provided by Dr. Wilson are practically not distinguishable.

MR. WHITCOMB: Direct-examination closed.

Cross-examination.

By MR. MORRIS:

Q. Do you mind telling me, Dr. Clark, the substance of what you said a moment ago about your inability to distinguish chemically between PbO and Pb_2O?

A. I mean by that simply that any ordinary type of chemical analysis which requires that the material shall be dissolved, be put into solution and precipitated as lead sulphate, or any other approved method of quantitative analysis, could not directly give you a distribution between lead oxide and Pb_2O; both of them would dissolve.

Q. But when you isolate one half, if it exists, you could analyze it chemically, could you not?

A. Yes.

Q. Did you?

A. We did.

Q. How?

A. This very tiny part of material we had was dissolved and quantitatively measured; I mean the quantitative analysis for lead was made.

Q. Do you have that quantitative analysis with you?

A. I think I have it here somewhere, yes. With this sample, of course, the refractive index and the X-Ray patterns were made.

MR. WHITCOMB: Counsel for plaintiffs didn't know he had any additional tests, or he would have asked for them on direct.

THE WITNESS: I am sorry; I don't seem to be able to put my hands right on that. I have some of our original calculations here, but this was on another sheet. I will have to find it.

By MR. MORRIS:

Q. Have you a separate and distinct recollection as to what you did and the results that you obtained chemically?

A. Well, the results showed not quite pure—

Q. No, won't you answer me first?

MR. MORRIS: Will you read the question?

(The question was repeated by the reporter as follows:

"Q. Have you a separate and distinct recollection as to what you did and the results that you obtained chemically?")

A. Yes, I have.

Q. Will you be good enough to give me your recollection, and then I will let you supply me with the data tomorrow morning?

A. Yes. This material was analyzed for lead.

Q. How?

A. By the lead sulphate method.

Q. Which is what?

A. Solution of given weight of the material.

Q. And what was your weight?

A. Well, of course, these figures I don't remember in detail.

Q. Three or four pounds?

A. Oh, no. It was only a few milograms because of the small size of the samples; about a tenth of a gram.

Q. And about twenty-eight or twenty-nine grams in an avoirdupois ounce; am I right?

A. Yes.

Q. And it was about a tenth of a gram?

A. Yes.

Q. So it was about one two hundred and ninetieth of an ounce?

A. Yes.

Q. Was that the sum total of the material which you have designated as Pb_2O which you got by this centrifuge?

A. Not all of it. A portion of it had been used for X-Ray work, and a part for the microscopic work. Because of the size of the centrifuge in any given run it is fairly small.

Q. Out of all the exhibits that were given to you you got a gram of Pb_2O, as you designate it?

A. Yes.

Q. Or thereabouts?

A. Yes.

Q. Let's go back to our analysis. You took a tenth of a gram of your product, of your centrifuge—is that term accurately used by me?

A. Right.

Q. And you subjected it to chemical analysis consisting of what?

A. Dissolved in acetic acid, and, of course, the solution very greatly diluted, and then a precipitation made of lead sulphate, and the material weighed as lead sulphate, from which we calculated the lead.

Q. And the remainder of your analysis consisted of what?

A. Well, that is the only part of the analysis in-

volved; it is simply a quantitative analysis of the material for lead.

Q. You did not weigh your oxygen?

A. I did not.

Q. Then how do you know it was oxygen?

A. Simply because there was no—oxygen could have been determined by combining with hydrogen and weighing with water, and so on—the tests were conducted or permitted from this substance, simply warming this substance in the presence of air, and the practically pure, easily recognizable yellow PbO was produced by its oxidation.

Q. The difference of weight of oxygen in PbO or tetragonal litharge calculated as Pb_2O would be what?

A. I will figure that out in just a minute. PbO has a lead content of approximately 92.7 per cent; Pb_2O, a lead content of about 96.3 per cent.

Q. So that the difference would be approximately four per cent in oxygen content of a tenth of a gram where the weight of the lead in a tenth of a gram would be of the proportion of that calculated as PbO, and of the proportion calculated as Pb_2O?

A. Well, let's see: 93 per cent of one-tenth. Oh, 93, and calculate all as sub-oxide: .093, .0963.

Q. I thought you were still calculating; your final figures are what, Dr. Clark?

A. .93 calculated—that would be the weight in lead oxide; .0963 in sub-oxide.

Q. .0963 what?

A. That would be the weight.

Q. Of the lead?

A. Of the lead.

Q. In a tenth of a gram of your original material so that your oxygen would represent the difference; that is, those figures represent nine pins one-hundredth of a gram while your oxygen would represent

what percentage of the weight? About one plus a hundredth of the weight?

A. Yes, and lead oxide would be about a hundredth of the sub-oxide, calculated as sub-oxide about four one thousandths.

Q. So the difference in the weight of the oxygen which would be found in a tenth of a gram of your material, if it were Pb_2O and PbO it would be what?

A. The weight—

Q. Expressed in grams?

A. In grams as lead?

Q. As oxygen; the difference in the weight of the oxygen in grams?

THE COURT: 6 one-thousandths, isn't it?

By MR. MORRIS:

Q. You mean one tenth minus .093 would be the weight of the lead—

A. One would be 7 one-thousandths.

Q. 7 one-thousandths?

A. Yes.

Q. This would be the difference between the two?

A. No, that would be the oxygen as PbO; the sub oxide would be one tenth minus .0963; 37 ten-thousandths.

Q. So, had you weighed your oxygen you would have had to be correct within one thirty-seven ten-thousandth of a gram to determine whether you were dealing with PbO or Pb_2O?

A. Exactly.

Q. Did you endeavor to obtain the heat of reaction with respect to any of your so called Pb_2O?

A. Heat of reaction, may I ask do you mean heat of oxidation, or what?

Q. In any way; calorimetric reaction?

A. We made no calorimetric measurement.

Q. The only test you subjected your so called Pb_2O to were, one, a partial chemical test consisting of the treatment of your product with acetic acid and then with sulphuric acid, and then weigh the lead sulphate; that was the beginning and ending of your chemical test of this Pb_2O?

A. It was simply because these—

Q. I am sorry; pardon me.

A. —because the high equivalent weight of lead makes the chemical analysis for it very difficult, so relatively easy to misinterpret.

Q. So far as you know, now, no one ever born on this earth has ascertained the existence chemically of Pb_2O?

A. I shouldn't say that, no, I am not certain of that.

Q. Won't you identify the man?

A. I don't know the man.

Q. I said so far as you know; that was in my question?

A. Oh, yes.

Q. Does that change your answer?

A. I might say in answer to that in chemical literature you can find not only chemical analysis for lead sub-oxide, but heats of reaction. One man finds, for example, positive heat of PbO to Pb_2O; one finds negative reaction. One of these men was, I believe, a man by the name of Tanatar.

Q. And another was Hershckowtsch?

A. Yes.

THE COURT: Do you want to go on to five o'clock?

MR. MORRIS: I think so.

THE COURT: It is all right to me.

By Mr. Morris:

Q. That is the only answer you can give to the question I asked?

A. Absolutely.

Q. Will you examine, please, Plaintiffs' Exhibits 13, 14, and 15, and as I understand it, you have testified that they truly represent a machine disclosed, respectively, at patents 149, 150 and 151; that is, any person could make those machines from the disclosures in those patents, as I understand it?

A. I think so in the essential details.

Q. There isn't any question about it, is there, Dr. Clark?

A. No.

Q. What is there disclosed in the patent 020 which is not disclosed in patents 149, 150 and 151?

A. I haven't any copy of 020 here; I will have to refresh my mind.

The Court: What is the question?

(The question was repeated by the reporter as follows:

"Q. What is there disclosed in the patent 020 which is not disclosed in patents 149, 150 and 151?")

Mr. Morris: Read the question before that.

(Questions and answers were repeated by the reporter as follows:

"Q. Will you examine, please, Plaintiffs' Exhibits 13, 14, and 15, and as I understand it, you have testified that they truly represent a machine disclosed respectively, at patents 149, 150 and 151; that is, any person could make those machines from the disclosures in those patents, as I understand it?

A. I think so in the essential details.

Q. There isn't any question about it, is there, Dr. Clark?

A. No.")

THE WITNESS: In Claim No. 1—

By MR. MORRIS:

Q. I am not speaking about claims at the moment, Dr. Clark; I am speaking of the disclosures, the essential disclosures.

A. There is no difference in the essential disclosures as respecting a mechanism production.

Q. Then the claims of 020 are for specific narrow features, I take it?

A. If I remember rightly.

Q. Will you point out the particular detail that you now have in mind that is not covered by the illustrations which you say are in Plaintiffs' Exhibits 13, 14, and 15 that are not disclosed by patents 149, 150, and 151, the claims in issue being 10 and 11; you need not trouble yourself by any of the others?

A. Claims 10 or 11; I can't see any new features which are not included under these other claims.

Q. My understanding is, then, you find nothing in either claims 10 or 11 which is not fully disclosed by patent 149, again by patent 150, and thirdly by patent 151; is my understanding correct?

(No answer.)

Q. I couldn't find any, Dr. Clark, if that helps you any; but if you can, will you put your finger right on it?

A. Well, I don't; I don't see any essential difference. Of course, it does make a separate statement here to the effect, "and means associated with said

apparatus in which said lead suboxide may be converted into litharge while still in its dry state."

Q. Do you mean to say you don't get—

A. Oh, you do.

Q. Out of apparatus disclosed by your exhibits, 13, 14, and 15?

A. Sure.

Q. Dr. Clark, in Plaintiffs' Exhibit 21, being this series of photograms—what is your technical word?

A. Diffraction.

Q. Diffraction pattern; all right; what pattern on this Exhibit 21 most nearly resembles either 9, 10, or 11?

THE COURT: 9, 10, or 11?

MR. MORRIS: Perhaps my question is not clear. I will withdraw it and put it again.

By MR. MORRIS:

Q. Which of the patterns other than 9, 10, or 11 on your Exhibit 21 most nearly resembles in your opinion, either 9, 10, or 11?

A. Of course, none of them. All of the other patterns except the pure substances at the top, which are for reference purposes. All the other patterns contain lead and lead oxide in addition. The bottom pattern prepared by decomposition of oxalate has the greatest amount of the most intense lines corresponding to 9, 10, and 11. The next most intense lines are to be found in No. 13, which is within the inner surface of a lead ball taken from the Exide mill.

By THE COURT:

Q. Where did 14 come from?

A. 14 is by decomposition of lead oxalate.

Q. Not from the mill?

A. Not from the mill, no.

By Mr. Morris:

Q. Now, then, Dr. Clark, you answer me in terms of intensity. Do you mind answering me in terms of dimensions, and presence of lines?

A. I don't know whether I understand what you mean by dimensions.

Q. I mean distances between planes, interplaner spaces or distances; do you understand the lines indicating that is an X-ray spectrum?

A. Yes. These spectra are composites, all on the same photograph, all diffraction from many sets of plates simultaneously.

Q. Right. But those spectra are visible, of course: that is, you can see them?

A. Yes.

Q. Do you find any of the lines that are diffraction patterns, 9, 10, or 11 on Plaintiffs' Exhibit 21 in any of the other spectrograms in Exhibit 21?

A. We do.

Q. With which other spectrograms on Exhibit 21 do you find the lines most nearly superimposed?

A. With the exception, as I have mentioned before, of a few very relatively weak lines. Due to another substance unidentified in very small amounts in 9, 10, and 11, this pattern can be and is superimposed on all the others. Of course, it shows that many of the lines follow on top of each other; that is lead oxide and lead.

Q. Then what you have shown there, then, by your spectrograms, Nos. 9, 10, and 11, are a number of layers which you superimposed, for instance, on No. 1, don't you?

A. Well, a few of them, yes; might come near to No. 1, but the pattern does not superimpose No. 1.

Q. As a whole?

A. As a whole, yes.

Q. Dr. Clark, will you be good enough now to turn to pattern 149? Do you have that before you?

A. Yes.

Q. Tell me what is the maximum amount of oxidation as you understand that pattern that comes within its scope?

A. This is a process for preparing a material high in lead content.

Q. Will you read my question, please Mr. Stenographer?

(The question was repeated by the reporter as follows:

"Q. Tell me what is the maximum amount of oxidation as you understand that pattern that comes within its scope?")

By Mr. Morris:

Q. Disregard the Claims if you want to, but tell me in your answer if you have disregarded the claims. Let's take the disclosure and operate the disclosure within the limits of that disclosure and tell me what is the maximum amount of oxidation that one may get?

A. I don't think it would be possible to determine it or to say what the maximum amount of oxidation is. No temperature is specified here.

Q. Then the operator is free to use whatever temperature he pleases, isn't he, short of ignition?

A. No temperature specified. Of course, the temperature is conditioned, certainly, in part by an air pressure which is specified of 2.5 pounds per square inch passed into this drum while being rotated.

Q. Will you read me the answer, please?

(The question was repeated by the reporter, as follows:

"A. No temperature specified. Of course, the temperature is conditioned, certainly—")

By Mr. Morris:

Q. All right; how is it conditioned by that; explain it; how is it conditioned by that?

A. The condition is one of the various rates.

Q. How?

A. The rate of the air and the condition of the temperature.

Q. It does?

A. It does.

Q. Will you reflect a moment on that and tell me whether you are right?

A. Of course, I am assuming from this an air pressure apprehends a blast or a current of air with a differential of 2.5 pounds per square inch passing as a current through the mill.

Q. Very well. What is your volume of air that passes through the mill under that pressure? Does your volume have anything to do with temperature?

A. You mean the total volume of air within the mill?

Q. Whether the volume of air that passes through the mill affects the temperature by making it higher or lower?

A. The volume is not the effective matter; it is the rate at which the air current moves.

Q. All right. Is there any limitation upon size of the opening in the outlets of that pipe in 149? Not in the drawing, please, but in the patent?

A. Within this cylinder is fitted an air blower provided with small holes.

Q. Then the limit upon that dimension is what?

A. Small holes.

Q. Yes; they might be pin points or needle points?

A. Might be, but, of course, such a process we know would be commercially non-feasible.

Q. The operator of that process would be at liberty to obtain through that mill such volume of air at 2.5 pressure as he desired?

A. He would determine that by the size of his holes.

Q. But he could fix the size of his holes so far as this patent goes?

A. Yes.

Q. So that he can get any temperature he pleased, couldn't he?

A. Well, he would have to take into consideration, of course, radiation, size of the lead, size of balls, the auxiliary cooling apparatus, and things of that sort.

Q. He doesn't have to do that in patent 150, does he?

A. There is not a statement, it seems to me, in 150, that there is cooling provided.

Q. No, on the contrary, an insulating covering is provided, isn't there?

A. Provided around the rotating cylinder heat insulating apparatus to prevent the radiation thereof, yes.

Q. Does that tell you what your limit of temperature is in 149 at either top or bottom?

A. No specific values, of course, are given.

Q. The operator would be at liberty to operate that at any temperature he pleased provided he obeyed the intention in lines 91 to 96 in patent 149 which says: "It easily oxidizes, and spontaneously ignites, so that it is necessary to provide with a cooling apparatus to radiate the heat generated by friction when treating easily oxidizible metals, such as lead". Would not the

operator then be at liberty to use such temperatures as he desired for the particular operation in hand?

A. It is a very decided upper limit to what temperature he could use, that is, the point of suitering of the mass, the melting point of lead.

Q. That is 327 C., or thereabouts, isn't it?

A. It is.

Q. So he couldn't go above that?

A. You would have a solid mass.

Q. Of course, he would. So that his upper limit is the fusing point of the metal; is that right?

A. Unquestionably. At temperatures below 327 there is a centering effect.

Q. About what, Dr. Clark?

A. I couldn't give you an exact figure, but I would say fifty degrees below that?

Q. F. or C.?

A. Centigrade.

Q. So that would be ninety below 612, 612 being the equivalent, as I recall it—612 F. being, as I recall it, the equivalent of 327 C. 90 from 612 leaves you 522, so that he would at liberty to operate in any range under the disclosure of patent 149 that was below 512 F; am I right?

A. By no means would I put such accurate figures; I would simply estimate them.

Q. Ordinarily is that true?

A. I should think so, yes.

Q. Now, what is the low temperature?

A. 60 degrees centigrade.

Q. Isn't it rather peculiar, then, Dr. Clark, that where Mr. Shimadzu designed a low temperature in the use of the same process he asked for an insulating jacket to be put around his mill in 150, and when he wanted cooling, he could operate not a two hundred or three hundred and ninety-two F., but he put a cooling jacket to keep it down below 512, and he wanted a heat-

ing apparatus on his other mill of the same size, dimensions, and carrying through the same process to get it up to 200 C; can you reconcile the statements of the inventor with the test which you have just given?

A. Well, it would seem to me that the inventor was trying to include in his statement a range of temperatures. I think any of us would admit that a commercial process of sixty degrees centigrade would be entirely infeasible and would not work on a commercial scale and make a desirable commercial product. His intention, it seems to me, if I can read it rightly, is simply to inclose within a certain range of temperatures the possibility of reaction.

Q. What percentage of Pb_2O did you find in the product, theoretically or actually, of patent 149? Any?

A. I don't know that I have ever had a sample of 149.

Q. What is the greatest percentage of Pb_2O that you have found and been able to isolate in any product with such material as this?

A. Any mill product, you mean, or any product whatsoever?

Q. Any, whatsoever?

A. 30 per cent in a dissociate of lead oxide.

Q. Dr. Shimadzu didn't know very much about what he was disclosing in patent 150, did he, Dr. Clark?

A. He was using the art and the literature of the time as best he could.

Q. Oh, then, if I understand you, what Dr. Shimadzu was disclosing in patent 150 was not his invention but what he read in the literature of the prior art?

A. Not at all.

Q. Will you get me straightened on that, please?

A. It was simply the fact that in the literature from the time of Berzelius on, fifteen or twenty authorities, chemical authorities, of one nationality and an-

other, Berzelius and others, described a velvety black product of extreme activity just as we have indicated a while ago the chemical analysis. Berzelius was wrong when he said he had prepared a sample of lead suboxide, but the other has a pure substance and associated with a certain kind of material with certain properties—

Q. To wit?

A. Intense activity, a black color, a spontaneous burning, and so on; was well established, and when such a product was obtained in experiments, Mr. Shimadzu, I think it was only natural that he would assume upon the basis of what was then known that he was preparing by a different method a material which seemed to correspond in its properties with the suboxide of Berzelius and others.

Q. Did it correspond with Berzelius's, regardless of whether the proper chemical nomenclature or name for it is suboxide?

A. What Berzelius was preparing we now know by a repetition of his same experiments and by use of the X-ray method was phyrophoric lead in large excess.

Q. And what else?

A. Lead oxide.

Q. Consisting of what?

A. PbO, and, possibly, of course, as we know under heat conditions of 310 degrees centigrade, of actual lead suboxide.

Q. I am sorry, I missed the 310 degrees.

A. That is the best temperature we have found to give a determination of suboxide.

Q. Then, as I understand it, Dr. Clark, Shimadzu in not only patent 149, but including the paint patent and machine patent got what Berzelius got?

A. We make reference to the final product which

finally comes out of the mill. He did not prepare pure lead oxide any more than Berzelius did.

Mr. Morris: Will you read my question, Mr. Stenographer?

(The question was repeated by the reporter as follows:

"Q. Then, as I understand it, Dr. Clark, Shimadzu in not only patent 149, but including the paint patent and machine patent got what Berzelius got?")

By Mr. Morris:

Q. If that question is not clear, may I try to make it a little clearer? Do you make any distinction between the Berzelius product and Shimadzu's product?

A. I don't think I did.

Q. Then Shimadzu attempted to patent a chemical process, did he not?

A. He did patent a new chemical process.

Q. I am sorry. I will deal with that in a moment, but I meant a chemical principle, not a process?

A. The method of making the dissociation of lead oxide is a decidedly different process completely from the oxidation of metallic lead.

Q. Undoubtedly, but my question is founded on your previous answer, Doctor. I don't want there to be any misunderstanding between us: if my questions are not clear, I want you to ask me. My last one wasn't clear. I realize that now. I was dealing with the Shimadzu product. Perhaps my question didn't disclose that. Let's deal now with the product as separate and distinct from the process, because Shimadzu does have patent 150, Claims 14 to 17, or something like that, a product. As I understand you, there is no substantial difference between Shimadzu's product and Berzelius's product?

THE COURT: Now, then. I don't know: I am more or less at a loss on this, but as I understand it, are you talking about the thing that Berzelius said he got, or the thing he actually got; they were two quite different things?

THE WITNESS: Indeed, they were.

THE COURT: Do you mean what he actually got, or what he said he got?

MR. MORRIS: What he actually got.

BY THE COURT:

Q. The thing Berzelius actually got, is that properly described by any of these product claims of 150?

A. No. While Berzelius must have had a combination of metallic lead as we know it now, very finely divided metallic lead, and lead oxide, and lead suboxide, yet we must remember this decomposition took place in vacuum. Let us take two molecules of lead oxide; that would decompose into Pb plus PbO, plus carbon dioxide, plus carbon monoxide. Of course the carbon monoxide is removed and there is no danger of further reduction of lead oxide which is formed to metallic lead. In a reducing one, the whole process is entirely different from an oxodizing one, you produce by the dissociation of lead and lead oxide into lead suboxide, the amount of lead suboxide and of lead and of lead oxide being solely determined by this chemical composition: that is, if we take those molecules of lead suboxide in vacuum, Pb plus PbO, which, together, gives Pb_2O, plus carbon dioxide, plus carbon monoxide. That process is absolutely limited in vacuum to that type of reaction. When, however, that product is brought out into the air, then the very finely divided lead—you can duplicate any mill oxide you want to, practically speaking, by bringing out this vacuum material into an oxidizing atmosphere.

By Mr. Morris:

Q. As I understood you a moment ago, you told me that Berzelius had a mixture of lead, lead oxide and some Pb_2O?

A. Yes.

Q. And now you tell me that Shimadzu has under his 150 and his 151, and his 149 and his 020 patents, some lead fine lead, as in Berzelius', some PbO and some Pb_2O: am I right?

A. Yes.

Q. Wherein is there any substantial difference, then, between the Shimadzu product and the Berzelius product?

A. Which is as I have indicated, that the Berzelius product is limited precisely to one ratio of lead to lead oxide.

Q. That being?

A. One to one.

Q. Are your figures exactly right, Dr.?

A. We can write this equasion here: that is, by one to one I mean—

Q. Oh, my mistake: I was dealing in percentages instead of ratios. I understand you now. So that Berzelius had lead oxide and lead in a ratio of one to one?

A. Exactly.

Q. Where did Berzelius's Pb_2O come in, then?

A. Berzelius assumed, of course, that all of his product was Pb_2O.

Q. And he was wrong?

A. And he was wrong.

Q. Where does Shimadzu's product act differently from Berzelius's product?

A. Shimadzu's product containing finely divided lead plus PbO, plus lead suboxide, in the presence of an oxidizing atmosphere you can get, as you can read-

ily see, I think, a very wide range of distribution between these three components. As a matter of fact, you could get by the primary process a large proportion of lead suboxide or a large portion of lead, or one to one ratio.

By THE COURT:

Q. Didn't Berzelius have any lead suboxide in his product?

A. Duplicating his experiments, we can find some. Of course, he said it is all lead suboxide because he had no way—that is, the chemical analysis, and any observations he made were such as to lead him to believe he had something different—

Q. I understand that he didn't get what he thought he had. But you say he had lead and lead oxide in one to one. It may be lead suboxide in what figure there?

A. We might get as high as—

Q. One-twentieth?

A. 20 or 30 per cent. Every bit of lead suboxide which dissociates still gives us one to one.

Q. I understand that. How long would it take to dissociate: how long would he hold that product consisting of three things? I can't get anything out of it except your testimony there were three things in Berzelius's product, and they were separate things. They were all mixed up together, but three, actually three different things, lead, lead oxide and lead suboxide. When I read claim 15 I see that is a powder comprising a major portion of lead suboxide: 15 says a large portion of lead suboxide: 16 says a large portion of lead suboxide. Now, Berzelius had a powder with a large proportion of lead suboxide in it?

A. Yes.

Q. Or may have had?

A. May have had, yes.

Q. Was his product capable of spontaneous oxidation?

A. It was.

Q. Was it capable of spontaneous reaction and contact with moisture?

A. Berzelius discloses those experiments.

Q. Capable of spontaneous reaction on contact with air?

A. Yes.

Q. A highly chemically active powder?

A. Yes, it was.

Q. Isn't it perfectly described by those three claims?

A. As far as the actual constituents present, both the mill and Berzelius by entirely different processes could obtain mixtures of those three.

Q. That is all right; we are only talking about the product claims now. I realize you can reach identically well known products by a new process, a patent process. That is all right, but I can't see from your testimony where, if we know that Berzelius had what you say he had, if that is a fact; where it is not described perfectly by those three product claims, and, therefore, anticipates them.

Mr. Morris: I feel, if your Honor please, I am imposing on good nature.

The Court: I don't care; I can stay until six o'clock if you want.

Mr. Morris: I think that would be impossible; I suspend now, if you desire.

(Adjourned until Friday, September 27, 1935, at ten o'clock A. M., Daylight Saving Time.)

THIRD DAY.

PLAINTIFF'S EVIDENCE (Continued)

GEORGE L. CLARK, recalled.

Cross-examination (Continued).

By MR. MORRIS:

Q. I forget, Dr. Clark, the exhibit number that was given to the sample of the Pb_2O, so-called, produced by you yesterday. Do you recall what the exhibit number was?

A. The sample itself, you mean?

Q. Sample itself, of the isolated Pb_2O.

A. There is no—no sample was submitted.

Q. Well, then, will you be good enough to let me have a sample of the material that you isolated, which you designated yesterday as Pb_2O?

A. As soon as we got enough to present we shall do so, as the centrifuge experiments continue. The first lot was used up in these experiments, or practically all used up.

Q. I see. You got Dr. Wilson's sample in 1934?

A. Yes.

Q. Had them ever since?

A. We have.

Q. And with this stuff that Shimadzu said in his patent 150 he could produce, in effect, said, in effect, that he could produce ton after ton, you, a scientist and expert, have not been able to produce enough to produce even a teaspoonful here as an exhibit?

A. We can produce a teaspoonful. This supercentrifuge experiment is a long, very long, tedious experiment, in which a small amount of material is suspended.

Q. Why didn't you make it in the Shimadzu mill?

THE COURT: Will you pardon me just a minute?

(Interruption.)

THE COURT: All right, Judge, go ahead.

MR. MORRIS: Will the stenographer please repeat the question?

(The question was repeated by the Reporter, as follows:

"Q. Why didn't you make it in the Shimadzu mill?")

A. This experiment was not for the purpose of making lead suboxide, it was for the purpose of separating the constituents in a powder made by the Shimadzu mill, or made by an Exide mill, or made in these other experiments. That was the sole purpose of that experiment.

By MR. MORRIS:

Q. Well, if Shimadzu could make 93 to 97 per cent Pb_2O, and 3 to 7 per cent lead, the science of chemistry would teach you how to isolate and separate the lead from that Pb_2O, wouldn't it?

A. Yes.

Q. Well, then, there should be no difficulty at all in bringing a tankful of what is left, should there?

A. It is impossible to get out of the mill—there may be ninety-three per cent of suboxide in the mill at certain stages, or the process may have gone through ninety-three, or ninety per cent of the suboxide stage, but at elevated temperatures, under the conditions of operation of the mill, you can't get out a sample that has that much suboxide in it.

Q. Yes, but I am interested in Shimadzu's product. Does he tell you in patent 150 that what he is talking about is that he gets ninety-three to ninety-seven per cent in the mill?

A. In the mill, yes.

Q. He does? Have you a copy of the patent?

A. Yes.

Q. All right, let's turn to patent 150 and point out to me where it says that he gets ninety-three to ninety-seven per cent in the mill.

MR. MORRIS: Has your Honor a copy?

THE COURT: Yes, sir.

MR. MORRIS: What I am talking about is column one, patent 150, lines 50 to 54, or any other place that Dr. Clark may point out.

A. It says that the product of this invention, the composition of powder is approximately ninety-three to ninety-seven per cent lead suboxide. That does not, it seems to me, designate that the product—where the product necessarily is, whether it is outside of the mill or inside of the mill.

By MR. MORRIS:

Q. Oh, what he is patenting here, as you understand the patent, is not something that could be used commercially, not something that could be obtained, but he is disclosing to us that he has found the chemical reactions that take place in the mill when litharge is being made by a mill, is that right?

A. There is certainly not ninety-three per cent of suboxide in the final product borne out in the current of air, and yet we maintain, that is, the mechanism is such that on the interior of the mill, in the process of production of the powder initially, that it may contain—

Q. Dr. Clark,—

A. —such amount.

Q. —my question is for you to be good enough to point out to me anything in patents 149, 150, 151, 152, or 020, or 479 that says one single word about the composition of the product in the mill.

A. There is—there is—no statement is made about the composition of the product in the mill or out of the mill.

Q. You testified here yesterday as a patent expert explaining to us your understanding, your grasp of the patents in suit. Is it your understanding that the product of a patent, which product is covered by claims of the patent, means something that is so fugitive, a chemical reaction in the mill, that not a spoonful of that product can be isolated or found in the ultimate product covered by those claims.

A. Why, I understood what you say, but just the question which you want me to answer I don't believe I understand.

Q. Well, then, we will try again, please. Dr. Clark, you testified yesterday as a patent expert. Am I right so far?

A. I testified as an experimental chemist.

Q. Well, you explained the patents to us, didn't you?

A. I read the patents, but I—I make no claim of, legal claim of being able to put any legal interpretation upon the words of this patent or these patents. I am an experimental chemist.

Q. Oh, you want to withdraw your qualification now as a patent expert?

A. I don't withdraw my qualification as a—

Q. Well, then, let's go back to our primary question. As a patent expert, and one who understands the patents in suit, is it now your testimony that what Mr. Shimadzu covered by his product claims in suit

was the product that appeared, at least theoretically, in your opinion, during the process of the making of the product covered by his claims, and was not to be found in, or did constitute a major portion of the ultimate product of 150?

A. Well, there is only, there is only, certainly, one answer to that question, and that is this (when the statement is made of a composition of powder containing ninety-three to ninety-seven per cent lead suboxide, that can refer only to an intermediate product, not the final product).

By THE COURT:

Q. And do you think that applies to the claims 15, 16 and 17, the product claims of the patent, also? For instance, the final product, as I understand it, does not contain a major portion of lead suboxide. Is that your understanding, or am I right about that?

A. The final product—it just depends upon our interpretation of "major", of course. The final product, if we think of "major" as being fifty-one per cent, it does not contain it.

Q. Yes, well, do you think the final product contains a large portion of lead suboxide, the final, commercial product that he makes?

A. It does not.

Q. Well, of course, then, you are correct in saying there was only one answer to Judge Morris' question, and you have answered it that the product claims cover a product which is an intermediate product,—

A. Yes.

Q. —but which disappears as an entity, as a product, when the process is completed?

A. That is right.

THE COURT: All right, now, that is very clear.

By Mr. Morris:

Q. May there not be another answer to my last question?

A. Why, I don't—I don't think of any, just at the moment.

Q. You told me yesterday that the renowned Berzelius didn't have what he thought he had. I wonder if you are placing Mr. Shimadzu, attributing to him a greater ability in that line than you do to Mr. Berzelius?

A. Certainly not.

Q. Then there is another answer to my previous question?

A. Yes, I am glad you have mentioned that.

Q. And that answer is what?

A. That Mr. Shimadzu in speaking of ninety-three per cent, or whatever it is, might easily have been thinking of an exceedingly intimate mixture, variable mixture of lead and lead oxide. He was using, when he used the word lead suboxide, was using—that is, taking that large quantity—was using the literature or the chemical state of knowledge of his time.

Q. In deed, I don't understand that answer. Do you mean to tell me, Dr. Clark, that Mr. Shimadzu was calculating in his product as Pb_2O—PbO, and converting that theoretically into Pb_2O, and then telling us that he had gotten this product to that extent?

A. No, not at all.

Q. Then I misunderstood you.

A. Yes.

Q. Won't you tell me, please, Dr. Clark?

A. Shimadzu felt that, reading the experiments of—in the literature from the time of Berelius on down through all these books, read of the discovering of the properties of a substance which he called lead

suboxide, or which was called Pb_2O, and in the initial experiments in Japan there were certainly produced—

Q. What is that?

A. In the experiments in Japan—

Q. Oh, you were there? You are testifying as an expert—

A. No.

Q. —from what knowledge?

A. From the examination of oxide samples from Japan.

Q. Produced when?

A. Well, over the last several years. Of course, I didn't know anything about the original experiments, never seen any specimen at all.

Q. I wonder if it wouldn't be well for us to speak about the samples of which you have knowledge, and not speak of what was originally produced in Japan.

A. Yes, I never have seen those.

Q. All right, then if you will be good enough to confine your testimony to those things you know, or about which you are speaking as an expert from facts which you know, you may be guilty of less inaccuracy.

A. Well, to reduce the thing to a nutshell, the situation is this, Shimadzu thought, based upon the literature, that he was making lead suboxide, and we feel in accordance with the mechanism, the study of the production of Shimadzu's mill, that lead suboxide was and is being produced, not in a pure form, but in an intermediate stage, ninety per cent or more of the final product or the actual production of the material has gone through a lead suboxide stage, and has then undergone dissociation into lead and lead oxide.

Q. Now, then, you as an expert are interpreting these patents to cover, then, the reaction which takes place in the formation of any lead oxide, is that true?

A. Yes, that is just as we have stated before, that

there may be formed in an intermediate stage lead suboxide, because we know that and contend that lead suboxide does exist as a very fugitive compound, which dissociates under the proper conditions and is no longer present in such amounts in any final product.

Q. So what Mr. Shimadzu is attempting to do, as you construe his patent, was to monopolize that reaction which takes place in the mill, if it does, and not, and did not disclose to us, either a product of the character of that described by him, or the process of utilizing, or disclose to us a chemical process that would have utility in producing and giving us the product of that process, is that right?

A. Well, according to my understanding, I don't see that there is precluded the possibility of taking any product which is formed as an intermediate stage, or even as a final product, and changing that or allowing it to change subsequently so that it can meet any specific needs of a commercial product for a commercial use that might be needed.

Q. Is it your thought, Dr. Clark, that all oxides of lead, the higher oxides of lead, have to pass through, first, through the reaction of Pb_2O, or that the first oxidation of lead is in all cases Pb_2O, and then that it proceeds from that to the higher oxide.

A. Well, if we take a solid gaseous system, solid lead, and submit to that or bring together with that an oxidizing agent it seems to me that as a transient, initial stage, following the absorption upon the surface of the gaseous film, that it is a perfectly logical thing, now, you can take a piece of ordinary lead and let it simply stand in the air, all by itself, just as Berzelius, the very first experiments that Berzelius himself did, forming a dull skin on that lead. What is that, the question is, what is formed there, even at ordinary low temperatures? It is possible to find evidence of

lead suboxide in a film like that, mixed, of course, with basic carbonates and other things of that kind.

Now, I feel it is a perfectly logical thing, in accordance with the models which I explained yesterday, that when you bring metallic lead and a gaseous oxidizing agent together that as a first step, it is the most logical thing that we could picture, and does not mean to say that all oxides of lead, by all methods whatsoever, necessarily have to pass through any suboxide stage.

Q. Let us make litharge by a process that does not have to pass through that step. What would that process be?

A. I do not think that lead suboxide necessarily needs to be formed with molten lead.

Q. But any oxidation of even the shot which I carry in my charged shells when I go hunting has lead suboxide on it, according to your theory?

A. If those shot become covered with a—with a dull coating, and by exposure to air, especially in the presence of moisture, it is entirely possible, in fact, I think it is entirely—it is true, very probably, that suboxide has at one stage or other existed in a very transient stage, when oxygen has first entered the superficial layer of lead atoms. Of course, as I say, the cover of that shot will also have basic carbonates and other constituents of that kind, basic sulphates, and so on, in ordinary air.

Q. So, as we understand each other, then, I take it that what Mr. Shimadzu patented in 150 is what went on in the mill, and not the product that came out?

A. Yes, that is right.

Q. Dr. Clark, won't you tell me what the minimum temperature is for operation of 149?

A. Temperature isn't specified in 149, as we found yesterday.

Q. Well, as a man skilled in the art, how long

would you operate it, could you operate it, and be within the patent

A. Well, certainly the temperature would have to be such as to produce a product. That might be a very low temperature, as we have found, possibly, at sixty degrees centigrade, some product is formed, though not—that is, the process is certainly not efficient in the sense of producing large quantities of commercial material at sixty degrees. I would say that the lower limit would, therefore, be that temperature where a product could be formed of the finely divided powder.

Q. So you are not quite in accord with Mr. Ishimura, then, when he says the product that is formed at 150 degrees F. is the same or substantially the same as that formed at 112 F.?

A. I beg your pardon, may I have that?

Q. Yes. I understood Mr. Ishimura to tell me under cross-examination that there was no difference between the product formed in the Shimadzu mill at 112 degrees Fahrenheit and the product which would be formed at 125, or 135, 146, 150, etcetera.

Mr. Schaffer: What page of the record is that on, Mr. Counsel?

Mr. Morris: I don't know, Mr. Schaffer.

By Mr. Morris:

Q. Did you so understand him?

A. I think, if I remember rightly, he said that the distribution of constituents within the powder is, of course, a function—or some words to that effect—is a function of the temperature. Of course, that is true.

Q. Well, I am glad to know that, but I didn't so understand it. Well, without taking the time to refer to the record as to what he did say about 112—suppose we do take that time.

Mr. Morris: Will you find me what Ishimura said about the 112 degrees, and 125 and 150 F.?

The Court: Page 128, he says:

"Q. Suppose—do you get any different product at 112 degrees Fahrenheit from 125 Fahrenheit?

"A. Well, it wouldn't be very much difference, as the temperature range is so close.

"Q. Would you get any different product at 125 Fahrenheit and 150 Fahrenheit?

"A. Pardon me, 100 and 150?

"Q. Between 125 Fahrenheit and 150 Fahrenheit.

"A. Well, I don't see exactly how much, but there will be some difference, little difference.

"Q. Difference in degree or a difference in character?

"A. Difference in oxidation.

"Q. Well, wouldn't there be the same difference between 125 and 150 Fahrenheit that you would get between 150 and 175?

"A. A slight change, anyway.

"Q. What?

"A. Little change.

"Q. It would be a change? Would it be one of character?

"A. As the temperature rises, according to temperature rises the products change accordingly.

"Q. Well, suppose you operate at room temperature, would it be the same in character?

"A. No, if you operate at room temperature your product would contain mostly metallic lead. That is what I think."

By Mr. Morris:

Q. Do you agree with Mr. Ishimura as his testimony has been read?

A. Well, if we understand by the change in the product simply a—because of the varying temperature

coefficients of all these things that are involved, a different distribution in the product, different relative amounts of the constituents of the powder, I think there is no question, but even at the lowest temperatures you would have a lead and a lead oxide, PbQ, and lead suboxide.

Q. That is, if you introduced air in your mill?

A. Yes. Of course, that doesn't take into consideration at all the efficiency of the product, or the production of the commercial material.

Q. No.

A. It is just a purely laboratory experiment type of thing.

Q. So that to get into any utility, substantial utility for commercial purposes it would have to be at least sixty degrees centigrade?

A. It would have to be higher than that. That is just a lower possible range.

Q. And then would run on up to—

A. Two hundred degrees centigrade.

Q. Two hundred degrees centigrade. You are speaking about 149. I take it, aren't you, patent 149?

A. Yes, yes.

Q. Dr. Clark, won't you be good enough to look at this drawing over here? As I understood you in one of your answers a moment ago you spoke of the necessity of blowing the material out of the mill. Now, I may have misunderstood you, but that is the way I did understand you. Was my understanding correct?

A. The necessity of blowing it out of the mill? No, I didn't intend to make any such statement as that.

Q. Then it is not necessary, then, to blow it out of the mill?

A. It is convenient.

Q. But not necessary?

A. Not necessary for the—for the continuation—or, for a chemical reaction to take place within the drum.

Q. That is, if the first step in oxidation of lead is Pb_2O, that first step will take place in the mill regardless of the length of time that you permit the powder to remain in the mill thereafter?

A. Of course, the longer the time—that is true—the longer the time at those elevated temperatures certainly the less probability of the existence of any lead suboxide at all in the product which is finally taken out.

Q. With that we are not particularly interested, are we.—

A. No.

Q. —the final product? Your answer to that is "no"?

A. No; not right now.

Q. Are we or are we not particularly interested in the product that comes out of the mill?

A. Well, I think in many respects we are very much interested in the product which finally comes out of the mill.

Q. Well, I thought we were interested only in the reactions which take place in the mill?

A. Well, those are—

Q. Am I right or wrong?

A. —two separate considerations, of course.

Q. Well, do you understand patent 150 to tell us how to get Pb_2O in the mill, or what is it?

A. Exactly, it is to produce a reactive powder in the mill containing a large proportion of lead suboxide.

Q. I see, and not a process for making a product that—the product that comes out of the mill?

A. Well, I think it is—I think it is, you have to get the product out to use it, and it seems to me that the

process also involves a convenient method of removing the product from the interior of the mill which has been formed by certain chemical reactions, clear outside of the mill.

Q. Would the Pb_2O, so-called, that forms under your theory in the mill the increased in amount or decreased in amount in accordance with any temperature curve?

A. We positively know that the dissociation of lead suboxide is very sensitive to temperature. I may illustrate that—

Q. No, now, Doctor,—

A. Yes.

Q. —I asked you about the formation and not the dissociation.

A. The formation proceeds, the formation of lead suboxide proceeds just exactly—the rate may change—the lead suboxide formation at an elevated temperature may take place in just the same mechanism.

Q. I am afraid we are still at just a little cross purposes, either I don't understand it, or I haven't made myself clear. May I try again?

A. Yes.

Q. I am wondering whether the probabilities of the formation, the probabilities of the reaction of Pb plus PbP, forming into Pb_2O, according to your theory is expedited by any increase or decrease in temperature from room temperature.

A. It is, the rate of formation is expedited by an increase of temperature, up to an optimum.

Q. Then it is expedited or accelerated by increase of temperature, the other conditions remaining constant?

A. Up to an optimum temperature.

Q. Where would you fix that optimum?

A. Well, it is, let us say, in the—certainly below, somewhat below three hundred degrees centigrade.

Q. Well, the three hundred degrees centigrade is pretty close to the fusing point, isn't it, which is 327?

A. You mean of lead, yes, that is true, but I am speaking of the rate of reaction of Pb_2O, itself.

Q. Well,—

A. Perhaps I ought to—

Q. No, I am sorry if I interrupted you.

A. Yes, there are no experimental data bearing, no data at all bearing upon the rate of formation of Pb_2O as a function of temperature in such a mill as this. We do have data on the formation of Pb_2O from lead oxalate, laboratory experiments of that sort.

Q. I wasn't going to ask you for your data on that, at least, I had no thought of it at the moment, but as an expert and a scientist, other conditions remaining the same, other factors remaining the same, and conditions the same, you would expect, would you not, the reaction which we have spoken of as the Pb_2O reaction in the mill to be accelerated by increased heat, up to approximately three hundred degrees centigrade?

A. Yes, that is probably too high, too high a temperature, that is—that is merely a very rough—

Q. Oh, well,—

A. —higher limit.

Q. Well, of that order. What difference do you find in the process disclosed in 149, patent 149, and patent 150 and patent 151?

A. What difference in the process?

Q. In the process, yes.

A. No essential difference in the process.

Q. Not—

A. Outside of the point of cooling and heating which we spoke of yesterday.

Q. Well, which I didn't understand, and we will come back to that in a moment,—

A. Yes.

Q. —so that you will help me out on that, but the processes of those three patents are the same, indeed; the claims of process claims of 150 and 151 come within the scope of claims 1 and 2, one or two, one and or two of 149, as you interpret those claims, Dr. Clark. Let me read to you, for instance, claim—I will tell you which one it is—of 150,—

A. All right.

Q. —and you can take either claim—take claim two of 149, and let me read you claim one of 150:

> "A process of manufacturing a fine powder of lead suboxide intermingled with powder of metallic lead, comprising in putting pieces of metallic lead in a rotatable vessel in a dry state, introducing into the said vessel currents of an oxidizing gas to oxidize the surface of the lead while rotating the said vessel, and abrading off the oxide formed on the surface."

If I should do that would I be infringing claim two of patent 149, according to your—as you interpret it?

A. Well, as I interpret, there is very slight difference, claim two of 149 purports to form a material containing a higher proportion of lead, metallic lead.

Q. Where do you get that, Dr. Clark?

A. Well, in claim two it simply says "A method of forming a finely divided chemically reactive lead powder."

Q. But I thought we were under the impression, I was under the impression—withdrawn—I gathered yesterday from what you told me that it is not possible to obtain lead powder by rumbling lead balls, and consequently that—in an inert gas—

A. Yes.

Q. —and that consequently when it was done in a current of air we got a lead oxide?

A. Yes.

Q. Now, then, we have gone over 149, and we find that it is operating at the same temperature, 60 C., as a minimum, with at least up to 200 C. Now, then, I am wondering just exactly how you get the metallic lead powder out of 149.

A. Well, the process can certainly be conducted within a range, of course, that is, in any of these, the whole process itself, as regards temperature, and the amount of air, and the cooling produced by the air, and things of that sort, so that a varied product can be obtained. A pure lead powder cannot be obtained.

By THE COURT:

Q. May ask a question to straighten me out? When you speak of lead powder you apparently, as a scientist, mean pure lead powder, or do you? In other words, to me, as a layman, when I speak of a lead powder I would include various degrees of oxides of lead powder. Now, is that right or wrong? In other words, if this powder here contains eighty per cent of lead and twenty per cent of lead oxide I would be inclined to call it a lead powder. Would I be right or wrong?

A. I think you would be right, that is, we can buy, in the chemistry laboratory, we can buy materials on the market, lead, metallic lead, which may have varying amounts of impurities present in it, in that, and still call that lead powder.

Q. You see, it makes a difference in interpreting these claims;—

A. Yes, sir.

Q. —because if a chemically reactive lead powder means pure lead powder, that is one thing,—

A. Yes.

Q. —but if it means a powder having a certain amount of lead oxide mixed up with it, then it might

mean simply the same product as 150, with a higher amount of lead in it.

A. That is the way—

Q. I don't know.

A. That is the way I interpret it.

Q. It depends on what the words lead powder mean.

A. Exactly.

Q. You see, after all, I don't have these test tubes and centrifuges, I have got to deal with words,—

A. Yes.

Q. —and it is a question of whether these words here on paper cover certain products or whether they do not, and it is a question of definition. Now, it is important, I should think, in this patent to know what the words "lead powder" mean.

A. Yes.

Q. It seems like a simple thing, but when you get down to it it may not be so simple.

MR. MORRIS: That is the reason I have been trying to inquire what are the differences in the disclosures of the two patents, and the differences in the limitations and restrictions of the two, to see whether the are not foursquare.

THE COURT: Well, he may be right, if lead powder simply means the same thing as 150, except having a higher degree of lead in it, and less lead oxide, I don't know. I mean, that is just a thought that comes to me.

MR. MORRIS: There is the difficulty I find with either interpretation, I don't care what interpretation he gives it, the difficulty I am finding is this, that the limitations of the two patents with respect to disclosure are exactly the same, that is, you begin in each at sixty degrees, the witness tells us,—

THE COURT: Oh, with regard to the specification.

MR. MORRIS: Yes, sir.

THE COURT: I am only speaking of the claims.

MR. MORRIS: Yes, but I assume that if we begin at the same point and end at the same point, and use the same steps, that is one thing. Now, I don't know whether the witness is interpreting—

THE COURT: Well, provided the steps are all absolutely narrow and defined that you can't do it any different way, but suppose by blowing a little more air on you get more oxide in the final product, there might be some excuse for two different patents, I don't know.

MR. MORRIS: I don't know.

By MR. MORRIS:

Q. Do you find any excuse in patent 150 for blowing any more air in than you do in 149?

THE COURT: Well, I said blowing air, I don't know, controlling temperature, I don't know what, but it just might be that instead of patenting one process they made—well, I will no doubt be enlightened on this later on.

MR. MORRIS: Well, I am trying to get some enlightenment myself.

THE COURT: All right.

By MR. MORRIS:

Q. Do you mind answering the question which I just—well, I will withdraw that question and put it this way: do you find anything in patent 150 that tells the man who is studying it and studying 149, too, that

he must use more air in 150 than in 149, or does it appear that he must use more in 149 than in 150?

THE COURT: They call it blasts of air in 150. I don't know whether they use that expression in 149, or not.

MR. MORRIS: 149 says 2.5.

THE COURT: 2.5 pressure.

MR. MORRIS: That is right, but it doesn't say anything about volume.

THE COURT: "sent out of the air-blower"; now, 150 talks somewhere—

MR. MORRIS: You see, in 65, 66, 67 on page 1 it says, "while air blast—

THE COURT: Yes.

MR. MORRIS: In 149—"having a pressure of 2.5 pounds per square inch, is sent out of the air-blower." so we get blasts,—

THE COURT: Yes, you do.

MR. MORRIS: —and a 2.5 pound pressure. As I read it, Dr. Clark, you get the air blasts where no pressure is given, in 150, I think it uses "blast" in 150; "gust", anyhow.

THE COURT: Gust.

MR. WHITCOMB: "Pipes to blow air thereinto", line 96.

THE COURT: Well, I don't even know if that suggestion is worth pursuing, even.

MR. MORRIS: Well, I have been trying to find out what the difference is.

THE COURT: Yes, I don't know, either.

By Mr. Morris:

Q. Can you answer the question now, Mr. Clark, please?

A. Well, I don't know that a final answer can be given. My interpretation is that the 149 patent possibly operating at a somewhat lower temperature, under somewhat different conditions, produces a lead powder, which may mean an impure lead powder, and, of course, in any current of air it will be impure.

Q. Yes, but, as I understand it, Dr. Clark, the man skilled in the art who is operating the process of 149 would get any degree of oxidation in his ultimate product that he desired, from the minimum to the maximum, wouldn't he, the same as he gets in 150?

A. If he varied the temperature, and, of course, had sufficient air present, and a sufficiently high temperature, why, he could vary the product, yes.

Q. But you take him through the same temperature range in 149 as you do in 150, so he would be at liberty to do that, then, wouldn't he?

A. I think so, yes.

Q. Now, Dr. Clark, I am interested in another thing, and I wish you would help me out on that just a little bit. I got the impression from all these patents, 149, 150, 151—well, I will withdraw that, because I think it isn't accurate.

Do you get any instruction in 149 or 150 or 151 to blow the powder out of the mill as soon as it is formed?

A. There is no statement in these patents requiring an instantaneous, if I remember rightly, an instantaneous—the necessity of instantaneous removal. In 150 the words are used, "it is convenient to utilize the force of the current thus caused to blow the powder formed out of the cylinder, and then collect it."

Q. Then you do not find that to be a process, a step

in the process, of the processes disclosed in 149, 150, 151?

A. In answer to that question, in 149, claim two, 149 has the following words: "removing the said powder from said vessel by means of said current of air."

Q. Yes.

A. 150, claim two, is the statement: "causing such blast to blow the powder produced out of the vessel."

Q. You find identity in substance there, do you?

A. Yes.

By THE COURT:

Q. Well, under those two claims, but, then, there are a lot of claims that do not say anything about it. Claim three doesn't say anything about it.

A. That is true.

By MR. MORRIS:

Q. If we may pause at claim two in 150, and come back to your preceding question just a moment later, if you follow the steps of claim two of 149 and claim two of claim 150 you get a time factor, Dr. Clark, that is the same, don't you?

THE COURT: Two of each one?

MR. MORRIS: Two of each.

By MR. MORRIS:

Q. Apparently the powder is intended to be blown out in each at the same time?

A. Yes, you have "removing" in the first case, and "causing" in the second.

Q. The second?

A. Same thing.

Q. Same thing. Now, does a time factor enter into the ultimate product, the other conditions remaining constant? I am not speaking now of this reaction in the mill,—

A. Yes.

Q. I am speaking of the product that comes out in the can.

A. Of course, as the product is maintained at the elevated temperature for a longer period of time oxidation could proceed more completely, that is, we can have a somewhat higher proportion of lead oxide. If the powder is retained over any period of time it is possible for the lead particles which are formed to grow into little balls, metallic balls. The net result of holding the product in the mill at the elevated temperature, that is, instead of removing instantaneously, therefore, is just simply to allow the oxidation to proceed a little bit further, and possibly to cause a grain growth.

Q. So that, the other conditions remaining the same, or constant, the blowing it out at an early stage, or as soon as formed would indicate to you, perhaps, that Mr. Shimadzu meant his ultimate product out of the mill to be higher in Pb_3O_4, so-called, than it would be if it were permitted to remain in the mill for a longer period of time.

A. Well, there is no question about that, and also, metallic lead, you must add that, too, metallic lead would have, some of it, and opportunity to oxidize.

Q. Then if Mr. Shimadzu was interested only in what went on in the mill and not in the product that he got he wouldn't care how soon you got it out or how late you got it out, would he?

A. Well, he would be, of course, he would be interested in the utility or the usefulness of the product, and undoubtedly guide or direct the operation of the mill to that end, to the best end.

Q. Why does the product have utility?

A. It is a product with valuable properties for storage batteries, primarily.

Q. Does the chemical property, whether it is Pb_2O or PbO, make any difference?

A. In the production, that is, in the production of a storage battery plate it makes no difference.

Q. So whether the—it not only makes no difference in the ultimate product, but it makes no difference as to whether your theory that it went through a Pb_2O stage in the mill is correct or not, does it?

A. Well, it makes a decided difference in conditioning grain size. In answering your previous question, of course, I was referring to the fact that any lead suboxide or PbO present when mixed in the paste for making storage battery plates with sulphuric acid, or by other means, of course, are instantly destroyed, and as regards any specific effect upon a plate, outside of the distribution of metallic lead and PbO, and the grain size of PbO, any lead suboxide is destroyed in the paste at the instant that it is made.

Q. Well, now, if I understand you, then, your thought is that the degree of fineness is of some moment?

A. Yes.

Q. And your further thought is, as I understand you, that the degree of fineness had by Shimadzu can be the result only of a reaction in the mill, because according to your theory a product, an ultimate product, of the fineness of that of Shimadzu cannot be had save by chemical reaction?

A. At least a large proportion must have passed through a molecular process, that is, judging by experimental data we have on any grinding, by any known grinding process, of a metal.

Q. I see, so it wouldn't make any difference

whether it is Pb_2O stage that it passes through or any other stage, as far as you know, provided it is the result of a chemical process?

A. Well, that is the important thing, yes.

Q. So whether you call that process—whatever you call it, provided you get fine powder in your ultimate product, that satisfies all the utilitarian requirements, does it not

A. If it would have the same degree of fineness and reactivity I should say that it did.

Q. I wonder, Dr. Clark, just where you got this part, I am referring now to Exhibit 14, Plaintiffs' Exhibit 14, supposed to illustrate patent 150, or the machine that is made obvious and clear from the description. I cannot find in there, Dr. Clark, and I am wondering where you do, the air that blows the lead dust out of the jacket that surrounds the drum after the lead dust has passed from the drum into the surrounding cylinder. Do you find that in the patent anywhere? I don't. Now, if you will, look for it.

A. May I ask, do you mean is there provided a definite piece of machinery for blowing air, or—

Q. No, the phraseology in the patent, as I understand it, is blowing the dust out of the cylinder in the way that we have been talking about. Now, then, we have blown it out, but you have added an extra step here, you have blown it not only out of the cylinder, perhaps, but you have also blown it out of the surrounding jacket, and I do not find any provision in the patent for that. Do you? The one I find is line 13 page 2: "If it is blown into, it is convenient to utilize the force of the current thus caused to blow the powder formed out of the cylinder, and then collect it."

Now the cylinder that I understand him to be talking about there is the cylinder or drum or mill having the charge in it.

A. Well, of course, this cylinder is pierced with these holes.

Q. That is right.

A. And any sufficient blast of air, don't you think the air would pass out through these holes?

Q. Yes, I think so.

A. Particularly as the balls are rotating, forming new, making available a new part of the drum continuously.

Q. But you interpose a draft there sufficient to blow it, the dust, out of the cylinder, out of the surrounding jacket, which I don't understand is called for by the patent.

THE COURT: Well, how about the words "then collect it"? You can't blow it out and let it escape, you have to do something to collect it.

THE WITNESS: Yes.

THE COURT: Of course, it could be collected by gravity, I suppose.

MR. MORRIS: That was what I had in mind. I don't find this step, and I am wondering where you find it.

By MR. MORRIS:

Q. Did you find anything else other than what has just been read to you?

A. No; I think—I think it is just assumed.

Q. Well, would—

A. Just as we have been speaking of, that the air can pass out through these holes, as well as straight through the drum itself.

Q. Oh, that is true.—

A. Yes.

Q. —but suppose you have a stack up here for the air to escape, and suppose we make this bottom a fun-

nel shaped device, and let it just pass out by gravity, then you are not required to give the air this additional function or duty of blowing it out of the bottom of the surrounding jacket, are you?

A. Well, the statement, of course, is made here in 150 that the powder produced, the powder produced—

Q. Yes.

A. —must be blown out of the vessel—blown out of the vessel.

Q. I wonder if you would mind answering my previous question.

A. Yes.

Mr. Morris: Will you read it, please, Mr. Stenographer?

(The question was repeated by the reporter, as follows:

"Q. —but suppose you have a stack up here for the air—")

Mr. Morris: Won't you let me change that?

By Mr. Morris:

Q. Suppose you have a stack at the top of the surrounding jacket, such stack leading upwards, and you have your surrounding casing or jacket funnel-shaped, beneath the rotating drum, so that when the product or dust produced in the rotating mill is discharged therefrom it falls by gravity through the funnel constituting the bottom part of the casing surrounding the rotatable drum. That would work just as well, would it not, as this disclosure?

A. Well, I wonder it—I doubt if it would, to answer it, and then I will say this, would it be possible for such arrangement to so perfectly regulate the air up the stack that you wouldn't have all sorts of tur-

bulent conditions in there, which would seriously interfere with any successful settling or gravity conditions? I think it would.

Q. You think it would interfere with the gravity conditions?

A. Such turbulence would, yes.

Q. I see.

THE COURT: I think that I will recess at this point for ten minutes.

(Recess at 11.13 o'clock A. M.)

AFTER RECESS.

GEORGE L. CLARK, recalled.

Cross-examination (Continued)

By MR. MORRIS:

Q. One or two more questions and we will leave 149 and 150. I wanted to get clear in my own mind as to whether the blowing out of the powder is one of the essential steps in the Shimadzu process, the blowing of the powder out of the rotating mill. You told me at one time, I read what is disclosed in lines 13 to 16 of page 2 of 150: "If it is blown into, it is convenient to utilize the force of the current thus caused to blow the powder formed out of the cylinder, and then collect it."

A. Yes.

Q. As I understand you, it is optional and not mandatory?

A. There is no other means provided in the ap-

paratus as disclosed in the specifications for removing the product except by using the convenient blast of air that is put in.

Q. I wonder if you are right about that, Doctor, because on lines 85, 86, and 87 he provides a cylinder, an iron cylinder pierced all over with holes one-eighth of an inch in diameter at the rate of four holes in one square inch; so gravity is a force, isn't it, that operates in the presence of this mill as well as elsewhere?

A. Well, gravity, of course, is always operative, but then we have to consider that in order to produce oxidation there is being blown into this mill a blast or gust of air, and inevitably that will have a great effect on what happens, not only in oxidation but in the removal of the product; the air has to go somewhere.

Q. Am I to understand from that answer that the operator doesn't have his option, but he must blow it out? I only want to know which road you take, that's all.

A. Well, if we take the two claims in 149 and 150, it, I think, very clearly states that the operator causes the blast to blow the powder out, and he removes the said powder from the said vessel by means of the said current of air.

Q. Yes. Then Shimadzu in 150 was mistaken in not only what he got, like Berzelius, but he was also mistaken in saying he had an option as to whether he utilized the force of the current to cause to blow the powder formed out of the cylinder?

A. I don't believe I quite understand the question.

Q. I only just want to know one or two things, Dr. Clark. There are two roads that the operator would have to travel; he is at the fork of the road, and I would like to know whether the signpost of this description tells him to go east or tells him to go west. Let's assume, I read: "If it is blown into, it is conve-

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nient to utilize the force of the current thus caused to blow the powder formed out of the cylinder, and then collect it." I want to know merely as to whether I, having this patent before me, am told by anything in it as to whether I have an option to go east or west, or whether there is something in this patent that makes it mandatory whether I go one way or the other?

THE COURT: Well, now, let's get along a little. Of course, Dr. Clark's opinion on that might be worthwhile having, but, after all, isn't that a question the Court has to determine?

MR. WHITCOMB: We were thinking of objecting, but we didn't want to interrupt.

THE COURT: The point is the substance of Dr. Clark's testimony is that he produces lead suboxide in a pure form separate and free. Now, then, he went on into the processes of this patent, and I suppose the examination is perfectly proper to cover the various steps of the process, but, again, we are back to the question of words. Here is a question simply construing words. There is only one claim out of the thirteen process claims that says anything about blowing the product out of the mill. Offhand, it doesn't seem to me that a suggestion in this specification, that it is convenient to use the force of the current to blow the powder out amounts to a limitation of all the other twelve claims. They don't say anything about it, don't claim it, and don't suggest it. That is the way it occurs to me. If Dr. Clark said the other thing, it might have some effect on my judgment, but it wouldn't conclude me.

MR. MORRIS: I am in accord with that thought. I could take a position in regard to that, but I am

not asking him to interpret the claims. Let's pass it.

By Mr. Morris:

Q. Dr. Clark, how many experiments did you make in an endeavor to obtain an isolated Pb_2O, so called?

A. We have made experiments from two Exide samples, Prest-O-Lite samples, and some other preliminary experiments both with water and with oil as a dispersing medium; six or seven experiments.

Q. Why did you select an Exide sample?

A. The pattern of the Exide indicated—that is, the oxide, itself, indicated, of course, the presence of lead oxide, PbO, and lead, and small quantities of Pb_2O as shown in the chart, the blueprint chart there.

It was simply a logical matter to try to extract from the Exide sample, and from a sample made in Shimadzu's mill side by side under the same conditions, any sort of material—of course, we were interested in the distribution of grain sizes to see what similarities or differences there might be in those two products.

Q. What other samples did you analyze beside the Exide sample? Won't you give them to me so I can take them down?

A. Two Exide samples, a Prest-O-Lite sample, and a fractionation of lead oxalate decomposition product. The Prest-O-Lite and the Exide both were conducted in two experiments, one with water and one with oil as a dispersing medium.

Q. And that was all; you made no other tests in an endeavor to obtain the lines that resembled those of Ferrari?

A. That's all the experiments in an essentially pure concentrated product.

Q. I see. They were the only products that you submitted to this supercentrifuge machine.

A. Supercentrifuge, yes.

Q. Two Exide samples, a Prest-O-Lite sample, and one lead oxalate; how many experiments did you make with these several products?

A. The X-ray patterns were made, the microscopic examination was made, the chemical analysis, approximate chemical analysis which we mentioned yesterday, and the studies of the effect of heat in vacuum or inert atmosphere, and the presence of oxygen.

Q. Now, that is the character of the experiments. What was the number of the tests that you made with the centrifugal machine?

A. To date, six. It is a long, tedious process, of course.

Q. You have put six samples through the machine?

A. Yes.

Q. That includes the ones you have mentioned here?

A. Yes.

Q. And those only?

A. Yes.

Q. Will you describe that machine to me as near as you can? It bears a resemblance to a cream or milk separator, doesn't it?

A. Yes.

Q. Same principle?

A. Same principle except, of course, that it is made of very fine tool steel.

Q. To stand the fifty thousand r. p. m.?

A. To stand the fifty thousand r. p. m.

By THE COURT:

Q. You will have to describe it a little more; I don't know how a milk separator works?

A. The type of centrifuge, of course, is a very rapid whirling. For instance, we put milk or liquid, or something of that kind into a suitable container.

Q. I understand what centrifugal force is. What does your machine look like? A cylinder or sphere?

A. It is a small cylinder into which suitable dispersing liquid may be introduced.

Q. Do you put this in liquid form?

A. It must be dispersed as liquid, yes. It isn't an air separator, but it is a suspension in a liquid, and, of course, this is operated through gears and with a motor, and so forth.

Q. Then it is very rapidly revolved; then what happens? What takes so long about it?

A. It is, of course, small, and only a small amount of liquid at any one time can be introduced.

Q. How much?

A. Well, just a matter—it can be made a continuous process.

Q. How much would you put in at a time of these samples?

A. Well, I should say maybe fifty cc., a hundred cubic centimeters.

Q. How many teaspoonfuls?

A. Let's see; half a cupful; something like that.

Q. Then you whirl the machine around; then what happened to the liquid?

A. Then there is separated off any solid material in suspension, very coarse particles are thrown out first to the periphery of the machine. Then any material that is so finely dispersed—that is, we fractionate in stages; and finally after running the same thing through, and through, and through—

Q. Then what happens when you stop the machine? How do you get out those particles?

A. There is a suitable collector; that is, one cylinder inside of another that makes the collection.

Q. Like a sieve?

A. Yes. What we have been interested in here,

especially, is in the liquid which passes on through in which there has been—the final liquid, the liquid phase in which is still suspended a solid so finely divided that it is not thrown out; the particles are not thrown out.

By Mr. Morris:

Q. So the center of it is something like the center of a whirlpool in which the greater masses are hurled to the periphery?

A. Yes.

Q. How large is this mill? I have never seen one. Does it hold liquid, or does it have a capacity of a cupful, a gallon or two gallons, or what?

A. Well, it passes through the rotating chamber, I suppose about a half a teacup at a time. We can put in a given amount and simply run that for any given length of time, say a minute and half, or we may have a large reservoir and admit liquid, and then, of course, take it off continuously, although the given amount which is being submitted to the whirling action is relatively a very small amount at a given time.

Q. I am afraid I don't understand the operation yet. Is there drainage from the bottom of this device from the central portion?

A. Yes.

Q. Constantly?

A. Yes.

Q. And there is an accumulation on the walls of the cylinder?

A. Yes.

Q. So that can be operated as long as you like until the outer wall is so laden with material that you need to start afresh?

A. Yes, you would have to do that after so long a time.

Q. I am a little confused about that, because you

told me a while ago that it took a long time to make this experiment.

A. What I mean by that is this: that we start with a very dilute suspension of powder of this kind. You can't put a large quantity of powder into a given amount of liquid, a very large amount of liquid with reference to the amount of suspended solid in it.

Q. A very large amount of liquid, is how much?

A. That can be, let us say, as much as ten liters to a very small amount of suspended material.

Q. What is the capacity of the mill, of the machine? I am trying to get whether it is a big machine—

A. No, it is small. As I was trying to say, you can operate it as a batch process; in other words, put in a very small volume and then let that finish, or you can continuously admit—

By The Court:

Q. I haven't got it clearly yet. When you say, "let that finish," how does it finish? You put your stuff into the machine and then you start whirling. Is there a dripping out of the bottom, the middle of the bottom, or what happens in the central part?

A. Of course, the liquid which remains flows out into another reservoir below.

Q. That flows out from the center?

A. Yes. That can be readmitted and recentrifuged time after time, as in the case of this experiment.

Q. What is the use of taking it out and putting it back again? Why don't you do it continuously?

A. Well, because, of course, you have a throwing out first of all, in the first instance, the coarsest particles, and each time that you submit this solution of suspension back again into the machine you get another deposit, you see, of a small particle size, and then of a smaller particle size, and so on, until finally you get no separation at all after you readmit it again.

By Mr. Morris:

Q. How long does it take to make one of those experiments, Dr. Clark?

A. Well, we must remember in order to qualify that and answer that, you must remember that we work under an inert atmosphere and this solution in which we are especially interested and from which we desire to collect the product—I don't mean, of course, solution, but the suspension, the liquid phase must be evaporated at a low temperature out of contact with air; otherwise, of course, complete oxidation takes place.

We had very suitable results by using a very low, boiling oil which could be evaporated off in an inert atmosphere, and the suspending and the running of the machine over and over again, and the preparation of this final solid under these very careful conditions runs well into—oh, it takes a couple of days, I should say, for an experiment.

Q. You began experiments with this machine when?

A. In July of this summer.

Q. July of 1935?

A. Yes.

Q. What was the material that you first used in the machine as a test?

A. We used—let me see; I guess we used Prest-O-Lite oxide first.

Q. Then your next was what?

A. Then Exide.

Q. What?

A. The Exide sample.

Q. Now, then, will you turn to your product, Dr. Clark, that you got from this machine and show me the reactions which you got from the product? Will

you be good enough to write out your tests on the opening product that you got in this machine?

(A tripod is produced.)

A. Yes, of course, our first interest was to make the X-ray pattern in accordance with the technique which we developed and which I explained. The second was a microscopic examination. The third was heating a small amount in vacuum. This product which is somewhat light colored, under these conditions darkens to a very dark gray which we have interpreter as this: (indicating), and when we have examined this product under the microscope and we find an intimate mixture of lead and lead oxide.

Heating in open air gives us instantly, almost, the yellow coloration of PbO. Then, of course, we made a chemical analysis of one of the products which, of course, is not very significant, I think.

Q. I missed the last part, Dr. Clark.

A. I say we made a chemical analysis which we discussed yesterday and which I feel is not very significant, any chemical analysis of a product of this kind with a high equivalent weight of lead.

Q. I appreciate your views, but I am interested in chemical analysis. Will you be good enough to take off the sheet you used and lay out another sheet for the chemical analysis, the chemical analysis you told me yesterday you made? I will be glad to have you show me your reactions.

A. Yes, we dissolved—the purpose of treating with acetic acid was simply—

Q. Won't you show me your reactions to the treatment with acetic acid, Dr. Clark?

(The witness writes on the tripod.)

Q. You treated your Pb_2O, so-called, with acetic acid?

A. It dissolves in acid, of course.

(The witness writes on the tripod.)

THE WITNESS: There is some indication in the literature of a monoacitate of lead, but I did not claim this was a monoacitate of lead at all; nobody knows.

Q. Is your formula for acetic acid right?

(The witness writes on the tripod.)

Q. You have counted only for one molecule of lead; what happens to it?

A. What is it?

Q. You did get this identical result as to PbO?

A. I am assuming that, yes.

Q. What have you done with this other atom of Pb that you have in your Pb_2O?

A. This compound reacts as a whole to give us, of course, two lead acitates.

Q. Now, then, you have got four acitates?

A. Oh, you want—

Q. I just want to know what happens. You have this here (indicating), and you have it only twice here, and now you have four of those.

(The witness writes on the tripod.)

THE WITNESS: Of course, it is necessary to state this: this work was done in air, contact with air. We have no evolution of hydrogen, no visible evolution of hydrogen such as we would have if we had metallic lead. This material reacts there as it is introduced and dissolved in acetic acid and PbO.

Q. Then your chemical test gave you stronger evidence of PbO than of Pb_2O?

A. Well, the chemical test merely for the purpose of determining the amount of lead in a given initial weight of lead.

Q. Will you read my question, Mr. Stenographer?

(The question was repeated by the reporter as follows:

"Q. Then your chemical test gave you stronger evidence of PbO than of Pb_2O?")

A. Well, the product in the presence of air acts as PbO, dissolves into acetic acid and leaves a residue.

Q. Will you repeat my question, Mr. Stenographer?

(The question was repeated by the reporter as follows:

"Q. Then your chemical test gave you stronger evidence of PbO than of Pb_2O?")

A. This is not being used as a chemical test for PbO or Pb_2O; that is the only way I can answer that question.

Q. Then the chemical test to which you subjected the ultimate product of your centrifugal machine told you nothing with regard to the existence or non-existence of Pb_2O?

A. It told us the presence of lead in this product with which we started, a value which, if I remember rightly, was 95.88 per cent., a little bit less than the theoretical for the lead suboxide.

Mr. Morris: If Your Honor please, this is

supposed to be a test for Pb_2O. Now, I think my questions are fair.

THE COURT: Well, yes, they are all right excepting he started out with the proposition that the chemical analysis he didn't consider significant, and he says that the only purpose of the chemical analysis was to determine the percentage of lead Pb. If the question can be answered, it is all right; it is a proper enough question. What is the last question?

(The question was repeated by the reporter as follows:

"Q. Then the chemical test to which you subjected the ultimate product of your centrifugal machine told you nothing with regard to the existence or non-existence of Pb_2O?"

THE COURT: I believe you can answer that question, can't you, directly? Did the chemical test, itself, give any indication one way or another?

MR. WHITCOMB: What chemical test?

THE COURT: This chemical test he is talking about. Of course, I refer to the analysis. What do you call it, quantitative analysis?

THE WITNESS: Quantitative analysis.

THE COURT: I am talking about that. That you put in by combining with acetic acid, or whatever it was; did that tell you anything one way or another as to the existence of Pb_2O? Can't you answer that question?

THE WITNESS: The numerical result of the

amount of lead present in this chemical test is roughly in agreement with a formula of Pb_2O.

By The Court:

Q. It did tell you something, then?

A. It did tell us something, yes.

By Mr. Morris:

Q. And likewise in agreement with PbO?

A. No.

Q. Wherein—

A. In numerical results the percentage of lead agreed much more closely with the formula of Pb_2O than it did with the formula of PbO.

Q. Let us see why; your percentage of lead was what?

A. 95.88 per cent., if I remember rightly.

Q. 95.88; do you mind putting it on that sheet?

(The witness writes on the tripod.)

Q. That was Pb?

A. That's Pb.

Q. Now, we didn't ascertain what the remainder was, what the 4.20 residue consisted of; did you insist you were trying this simply to ascertain the amount of lead?

A. That's right.

Q. Now, is there anything in ascertaining that amount of lead, does that tell you that it could not have been a mixture of Pb and PbO?

A. It is entirely conceivable with a mixture of Pb and PbO.

Q. Is it equally conceivable that it could give that percentage of PbO, that Pb_2O could give it?

A. Why, surely.

Q. Did you intend by your answer just a few

moments ago that your ascertainment of the amount of lead was not consistent with the hypothesis of the presence of Pb_2O than with the presence of PbO and metallic lead?

A. And the nature of the initial product.

Q. What do you mean by that?

A. I say this is the conclusion that this is more consistent with the existence of Pb_2O than Pb and PbO, which is derived by the nature of the original substance, an X-ray pattern, a microscopic examination, and so on.

Q. But I am right, then, in my conclusion that so far as the amount of lead is concerned, that it told you nothing as to whether Pb with PbO was present or Pb_2O?

A. Now, the final result without knowing the original product, that says nothing.

Q. What were the other steps which preceded that final thing which indicated to you the presence of Pb_2O?

A. This lead was determined as lead sulphate.

Q. That was determined as lead sulphate; will you give me all your reactions?

(The witness writes on the tripod.)

THE WITNESS: This, if course, was carried out in solution with the best technique that could be used, the sulphate precipitated, collected suitably, washed dried.

Q. All right. Let's start with your treatment of the product in the centrifugal machine with acetic acid. I observe that your first figures that you put there were two molecules of acetic acid with one molecule of assumed Pb_2O. When I asked you for the lead content you changed your molecules of your

acetic acid in number. Does that make any difference in your reaction?

MR. MORRIS: Read the question, please.

(The question was repeated by the reporter as follows:

"Q. All right. Let's start with your treatment of the product in the centrifugal machine with acetic acid. I observe that your first figures that you put there were two molecules of acetic acid with one molecule of assumed Pb_2O. When I asked you for the lead content you changed your molecules of your acetic acid in number. Does that make any difference in your reactions?")

A. I have already stated, of course, that this solution stirred and warmed with acetic acid was done in the presence of air in order to put into solution all the material possible, and it did go into solution, ultimately, the explanation which I give being, of course, that PbO, 2PbO, plus four $HC_2H_3O_2$.

By MR. MORRIS:

Q. What is this compound that you have introduced here; 2Pb of four?

A. No, 2Pb plus.

Q. Oh, thank you. Did you get any free lead as a result of your chemical reactions?

A. There was at first—I watched this carefully as the reaction was going on. The first residue which I could not account for as being due to some other substance present, and the X-ray pattern actually shows the presence of some other unidentified substance. But as the solution was warmed, stirred, the residue went into solution.

Q. Is PbO soluble in acetic acid?

A. Is PbO soluble in acetic acid?

Q. Yes.

A. Yes.

Q. Then that step told you nothing as to whether it was PbO or Pb_2O?

A. Well, the production, if there had been pure PbO, to begin with, obviously, the thing as we know would have quickly and instantly gone into solution.

Q. It would have gone into solution?

A. Yes.

Q. Yours did go into solution?

A. Ultimately, yes, but I said there was first a gradual residue which went into solution with some difficulty, but it finally did.

Q. Did that tell you anything about whether the material with which you were dealing was Pb_2O or PbO?

A. It told us this, that the product was not—that is, in the first instance as it was introduced into the beaker, wasn't pure PbO; it was something else.

Q. It was something else?

A. Yes.

Q. Are you assuming that that something else was Pb_2O that was delayed in reaction?

A. No.

Q. So that the material that hesitated to go into solution, that fact doesn't tell you whether it was PbO or Pb_2O you were dealing with, does it?

A. Well, it tells us this that I just tried to say. If we had in the sample PbO only, of course, that might be mixed with something in the process, but the compound might have been broken down with contact with acetic acid. I don't know what, but something was formed by the beginning reaction.

The fact it all did not act in uniform manner indicates to me, at least, that it was not pure PbO.

Q. It might have been PbO and some lead which became oxidized since this operation was carried on in the open air?

A. Possible.

Q. Did you get any comfort at all, Dr. Clark, out of the chemical reaction so far as the chemical characteristics of your ultimate product are concerned?

A. Not very much, I am frank to say so. If we could depend upon chemical methods in years gone by I think we would know a great deal more about these products.

Q. So far as I can understand you, Dr. Clark, we are no nearer Pb_2O than was Berzelius, when we look at it from the chemical standpoint; when we try to isolate it or determine its presence by chemical analysis?

A. I think that is true simply because nobody has ever had available a pure sample of Pb_2O to be able to know its properties. That is the reason we have turned to these other physical methods.

Q. Dr. Clark, what percentage of a product or an ingredient of a product would probably be shown on your spectogram? What is that word you used before?

A. Diffraction pattern.

Q. Diffraction pattern?

A. Yes. That is an excellent question, one in which all X-ray people are very much interested.

THE COURT: What was the question?

THE WITNESS: How much could you find from—

MR. MORRIS: Will you read the questions?

(The question was repeated by the reporter as follows:

"Q. Dr. Clark, what percentage of a product or an ingredient of a product would probably be shown on your spectogram? What is that word you used before?

A. Diffraction pattern.

Q. Diffraction pattern?

A. Yes. That is an excellent question, one in which all X-ray people are very much interested.")

THE COURT: You mean how much of the stuff must be present in order to show?

THE WITNESS: In order to show, yes. We know that depends, of course, on the nature of the substance, and also upon the X-ray technique which is utilized. The general belief, the general average of difference of one substance to another is probably one-half of one per cent., which is as small amount as could be shown, measured on a diffraction pattern.

In order to tell that, a very considerable number of experiments have been performed in my laboratory recently, especially with regard to the analysis of dust from mines, although this has nothing to do with this case, yet it does have something to do with the technique, in which very small amounts of silica, and things of that kind, are of importance and interest. I think we can place safely one-half of one per cent to one per cent. as an amount which can be registered particularly by use of a microphotometer on the films.

By Mr. Morris:

Q. Doctor Clark, generally speaking you feel you must have one-half to one per cent. of material as one of the components of the mixture in order to have it show up on your diffraction pattern?

A. That's right, without any doubt.

By The Court:

Q. May I ask a question at this point? This testimony of yours as to the experiments you conducted and what you find amount to practically a discovery, don't they, scientific discovery? Nobody else has ever X-rayed or seen this stuff?

A. Well, that's the way we feel about it.

Q. Would you say generally, without regard to this case it was a scientific discovery of some importance?

A. I think the application of the centrifuge method and the settling of a moot point as to the existence of an unstable compound represents a discovery.

Q. I mean is it a discovery—that is to say, the existence of the unstable compound, Pb_2O; is that a discovery that the world is apt to take note of?

A. It would be, I think, if it were published in a suitable scientific paper; it would be received with interest.

Q. Other people would be apt to duplicate or attempt to duplicate your experiments?

A. Yes, they would.

Q. To check up?

A. An illustration of course, is the fact that since the paper by Ferrari there have been half a dozen, six or eight or more papers trying to check him—

Q. Pardon me, what was the paper by Ferrari?

A. Ferrari was the man who made the first X-ray analysis and reported a crystal structure of lead suboxide.

Q. Oh, yes; that was at what time?

A. 1926, if I remember rightly, or '27.

Q. All he reported was crystal structure that was consistent with Pb_2O?

A. Yes, and the difference from lead and PbO, or the combination.

Q. Did you have more than he had in his lines?

A. No.

Q. I mean did he have as much as you had?

A. I don't believe, as we can mathematically analyze his spectrum, the lines correspond fairly well. Of course, we have what we think to be more accurate numerical data.

Q. Is that the only advance you have made over his?

A. We have proved or checked his assignment of a crystal structure similar to Pb_2O and Ag_2O that is consistent with our results.

Q. In other words, what did you do that he couldn't do? What have you got that he couldn't get, or what have you shown he couldn't show?

A. Well, the only thing that we could do would be simply, in the light of scientibe advance in apparatus, do something just a little more accurately.

Q Did he have a centrifuge?

A. Oh, no. He started with lead oxalate. It was his belief, he states in his paper that his product was practically pure suboxide of lead, and he got this cubic spectrum corresponding with Pb_2O and Ag_2O.

His work followed van Arkel, another X-ray man who investigated oxide mixtures. His experiments

were consistent with lead plus PbO, so there was a controversy, you see. Ferrari mentions this with the previous work of van Arkel in his paper.

In the paper it states he allowed his samples to stand some period of time, and he noted a change in the spectrum with the appearance after a period of some months, I think, seven or eight months, of lines corresponding to lead and Pb_2O.

Q. Now, you, as I understand it, started in with a machine which would isolate this substance if there was such a substance in existence; you used this machine and you got something in the final product. You took that thing and put it through your X-ray, and you got the same structure that Ferrari had gotten before you?

A. Yes. We had also found in the mixed samples, that is, the ordinary samples from the mills, and from lead oxide experiments we had obtained a mixed spectrum consisting of lead lines, of PbO lines, and of additional lines. These additional lines corresponded very well with the lines which Ferrari had reported.

Q. You had the advantage over him of starting out with something that was theoretically or provisionally free and pure; he didn't have that advantage?

A. He prepared him samples from the oxalate. He didn't know what he had until he subjected it to X-ray analysis.

Q. He didn't have the fractionating process?

A. No.

Q. These photomicrographs, did he have that?

A. Nothing reported in his paper.

Q. He could have?

A. Yes.

Q. But they are not reported?

A. That's right.

By Mr. Morris:

Q. What were some of the disadvantages of the X-ray test, the inaccuracies of the X-ray test, or is it perfect?

A. There are errors, of course, that must be recognized as follows: we must know or be able to calibrate very perfectly the radius of the camera which is used, since the position of the lines on the spectrum depends upon the distance, very accurately on the distance from the spectrum to the film, and any machine, camera of that sort, obviously, it would be a very limiting condition if it could be made absolutely perfect, perfect cylinder, or circumference, or something of that kind; that must be recognized, of course; shrinkage of the films, variation in the films. We can use, of course, in that sort of thing, for calizbration purposes, under exactly the same conditions as nearly as we can get them some standard very pure substance whose pattern can be produced, whose specifications are well known.

By The Court:

Q. Pardon me a minute. Does the X-ray report anything but the crystalline structure?

A. Well, that is in essence, that composite information is the crystalline structure.

Q. That is what you get; in other words, you may have that same crystalline structure with a number of substances?

A. You may have the same general architecture by the different ones in the sizes of the atoms; for example. I—

Q. I understand that statement, but what I was getting at was this: you start with lead an you know it is only one crystalline structure that will fit Pb_2O, of course, lead oxide. Suppose you didn't know the thing you were looking at was lead; suppose it might have been iron, aluminum, or a number of other minerals and you didn't know what it was. The X-ray plate for the lines wouldn't tell you what the element was you were dealing with; would would have to know that first, or am I wrong?

A. Not necessarily. Of course, there has grown up in the last few years a large compendium of information just like tables—they are tables in which are listed under a given crystal structure producing a given pattern, for example, very accurate numerical values corresponding with distances between plates.

Q. That may be different for different elements?

A. Oh yes. One single value distinct for each compound so that if that compound were known or had been studied it is already available in well known tables.

Q. In other words, you could take a powder you had no information as to what it contained and you could come close—by getting its crystalline structure you would be able to tell not only what particular oxide it was, but you would be able to tell what it was?

A. Yes, if there is data available, and there are many now.

By Mr. Morris:

Q. With no options?

A. I would maintain this in answer to that question: if a given substance, pure substance had been worked upon carefully in an approved laboratory

with approved methods by skilled operators, and certain numerical data were derived from those X-ray experiments by these skilled operators, skilled scientists that represents—that is the forms of crystalline axis and the alpha beta gama angles between axes, and so forth, would be distinctive for that substance. It is true there are some substances very close together, and unless work were very accurately done it is possible to confine them.

Q. Running to the third decimal point, perhaps, or second?

A. Section decimal point, perhaps.

Q. So that inaccuracy in the machine or operator going to the second decimal point might indicate one substances while the substance present is another?

A. That is possible in rare cases.

THE COURT: I think perhaps we might as well adjourn here.

(Recess was taken from 12.30 o'clock P. M. to 2.30 o'clock P. M.)

AFTER RECESS.

GEORGE L. CLARK, recalled.

Cross-examination (Continued).

By MR. MORRIS:

Q. Dr. Clark, which are the physical properties that are given in these specific patents in suit that you find in defendant's product?

A. First, the defendant's product may be characterized as reactive, as shown by the increase in weight and the various figures which were presented yesterday after noon, in simply a change on standing for twenty-four hours. It may be characterized by fineness of subdivision. It may be characterized as oxidized lead powder containing lead and oxygenated or oxidized lead compounds. It is characterized by having present small amounts of lead suboxide, even as finally obtained from the mill.

Q. How did you determine the amount of so-called lead suboxide in defendant's product?

A. The amount in the defendant's product was determined from the X-ray patterns, by use of the microphotometer curves, by comparison of intensities of lines.

Q. That would give you as accurate a determination as a chemical analysis?

A. I think it would give equally as accurate analysis for lead suboxide as any chemical analysis could, and that can be further qualified by saying that the lead suboxide is, at least, we think, identified as such in these mixtures, and its own concentration determined by this method.

Q. Do you look upon the X-ray analysis as auxiliary to or a substitute for chemical analysis?

A. Well, in this—in this case, where we are dealing with a compound, whose identity is uncertain, where it is present not as pure compound, but in mixtures, I should—I personally feel, after thirteen years of working day by day with X-ray methods, that it gives a more accurate picture of the state of affairs and the amount of substance than a chemical analysis could, and in so saying I do not wish to seem a traitor to the cause, by any means.

Q. A traitor to what cause?

A. To the cause of classical chemistry.

Q. A traitor to the cause of classical chemistry?

A. Yes.

Q. Is that equally true of any other substance that has come within your knowledge?

A. There are very many substances, at any rate, of which I may mention especially mineral mixtures, ceramic materials, soils, and all similar products, natural products whose chemical analyses, especially as regards the exact identity, the exact form in which a given substance is present. Chemical analysis does not give that to us directly. The X-ray diffraction analysis gives us the information concerning the identity of the compound, not only as a certain chemical substance, or chemical compound, but the way in which it is combined, its absolute identity as such in that solid.

Q. You spoke of the reactivity; is reactivity with a mixture of PbO and lead a matter of proportion or ratio? Is the degree of reactivity of a mixture of PbO and lead dependent in part, at least, upon the relative percentages of the two?

A. Yes, it is in part on the presence of unoxidized metallic lead, and also in part, of course, upon the fineness of subdivision.

Q. Well, the reactivity is a function in part, at least, of fineness, isn't it?

A. It is.

Q. Then if you had finely divided lead would it be reactive?

A. It would be, yes.

Q. Did you apply—

By The Court:

Q. May I ask a question?

A. Yes.

Q. All these claims of the patent call for a high degree of reactivity. Now, is that desirable in itself, or is that just something that goes with the fineness of the powder? Is the thing that you want in the commercial product fineness or reactivity?

A. Well, those are so parallel it seems to me in this case that you cannot separate one from the other.

Q. Well, but—I agree that they go together,—

A. Yes.

Q. — I understand that, but what do they want to get, really, what is the thing that they want? Do they want a fine powder, is that the important thing, the physical structure of the powder itself?

A. That is what they want for battery purposes.

Q. Now, what is the advantage of that? Why do they want it so v ry fine?

A. Well, as the chemical engineers who are acquainted with the storage batteries can tell you, a very fine material is a very great advantage, particularly in its cementing action in plates, and, of course, the rate at which paste can be formed and set up, almost a jelly.

Q. Well, it is really the physical quality that they are after, the fineness; the reactivity is something that goes with that?

A. Yes, of course, the second thing which must be added to that is that it is then very easy to take this product, very finely divided, and with very simple means subject it or get it at any stage of oxidation which may be desired for any particular purpose.

Q. All right.

A. The point is simply this, if we had little,

tiny lumps of lead that you could see in a microscope, those aren't very reactive, those wouldn't do anything.

Q. But those wouldn't be as good—

A. No.

Q. — for your cementing purposes?

A. No, they would not.

Q. The plates would crack?

A. Yes, and, of course, metallic lead would stay there unchanged.

Q. Yes.

By Mr. Morris:

Q. Did you find any of our product, defendant's product, was spontaneously converted into litharge by merely exposing it to air?

A. Yes, it is.

Q. What percentage of litharge did you find in it to begin with?

A. Let's see, there was thirty-seven per cent. of metallic lead, which in twenty-four hours was reduced to twenty-two per cent. of metallic lead, a change of some fifteen or sixteen per cent.

Q. That was in how large a quantity?

A. Those figures are given in Dr. Wilson's report.

Q. That was a question of grams?

A. Yes.

Q. And was not a question of tons?

A. That is right.

Q. So that there would be no such change in the commercial product?

A. Well, if we would take, of course, a great massive quantity, deep down, or something of that kind, obviously the oxidation takes place superficially,

depending upon the penetration of air, and the average oxidation if you take the average of the whole mass probably should be less than this quantity.

Q. You found thirty-seven per cent. of pure lead, you say,—

A. Yes.

Q. — or lead powder?

A. Yes.

Q. And sixty per cent. of—

A. Sixty-three per cent. of PbO.

Q. Litharge?

A. Red tetragonal.

Q. Red tetragonal litharge. Now, did you find that that product, I am not speaking about metallic lead now, but the product as a whole was spontaneously converted into litharge by merely exposing it to air?

A. Well, of course, the product as a whole is not spontaneously converted, because some of it is already there.

Q. I mean—

A. That is, sixty-three per cent. of it is already there.

Q. Did you find it would ignite and burn when you subjected it to the heat of a match?

A. It does not.

Q. Did you find that—what was its reactivity or degree of reactivity when subjected or treated with a drop of water?

A. Not very much change, a slight change in color, if you put a thin layer out on, say, a watch glass, and add a drop of water, there is an easily indicated change away from the olive-green type of material towards a more nearly pure yellowish litharge color.

Q. Would that be the result of any change in the body of the substance, or only a further oxidation of the fine particles of lead, the thirty-seven and one-half per cent. of lead?

A. Well, that is the primary change concerned, of course.

Q. That is, if you spread it out so the drop of water will not be—so that the drop of water can reach the thirty-seven and one-half per cent. of metallic lead—

A. Yes.

Q. — it will oxidize that?

A. Of course, in contact with air.

Q. In contact with air, of course?

A. Yes.

Q. Well, you answered me, it would not ignite. Were there any other properties which you found, physical properties or other properties which you found in our product which are described as the characteristic properties of the product of the patents in suit?

A. Well, there is—from the observations and experience, not from direct use myself, or trial, of course, very suitable for use in storage batteries.

Q. Are you an expert in storage batteries?

A. No, I don't claim to be that.

Q. Are you—

A. I am just simply telling you—

Q. Are you speaking of your own knowledge about material suitable for storage batteries?

A. I know that it is good for storage batteries.

Q. You do know that it is good?

A. Yes.

Q. Have you your calculations and measurements for the tests which you made with respect to lead and lead oxides by your X-ray method?

A. I will be glad to submit here a numerical calculation of a pattern for Exide oxide as a typical type of analysis, numerical analysis, which we have used in this case.

Q. This is the same analysis as is represented by your—that is represented by the spectogram number 9 on Plaintiffs' Exhibit 21?

A. That—

Q. I am not sure whether 9 was the—

A. This calculation, this particular calculation, is for the whole oxide.

Q. For what?

A. That is for the oxide itself, the initial substance, lead, lead oxide and Pb_3O.

Q. Now, did you say this was for the Exide?

A. Yes.

Q. And that, you say, is represented by which one of these spectograms of diffraction patterns on Exhibit 21?

A. Well, whichever one says the Exide, that is a typical analysis.

(The witness indicated the spectogram.)

Mr. Morris: It is number 6. May I have this marked for identification? This is defendant's for identification A, right here, and that is B. Will you mark it?

(Formulas written on the easel by the witness Clark were marked Defendant's Exhibit A for identification.

Numerical calculation of pattern for Exide oxide was marked Defendant's Exhibit B for identification.)

By Mr. Morris:

Q. Have you your like measurements for number 7?

A. Number 7 is what, there?

Q. Number 7 on Plaintiffs' Exhibit 21, which is number 3, after moistening with water and drying in a vacuum, and number 3 is tetragonal PbO.

A. Well, I don't happen to have those calculations here, no.

Q. Will you be good enough to get them for me?

A. Yes, I can get all those.

Q. What others have you here? Have you number 9, which is a finer fraction of finely divided number 3?

A. Yes.

Q. May I have those, please?

A. Those have all been calculated in the same way.

Q. May I have that one, please?

A. I have just that one representative sheet here. We have all the data in books.

Q. Have you the books where you made your data and calculations?

A. Yes, I can present them.

Q. You will bring them?

A. Yes, I will.

Q. This is the only one that you have here?

A. Yes.

Q. Now, did you make any X-ray patterns, diffraction patterns, for any products other than those disclosed on Exhibit 21?

A. Yes, those, the actual films, are in evidence for many more samples than that, and then, of course, we have made, as I said, in the course of this whole investigation possibly five hundred exposures.

Q. What other products did you analyze spectographically—would that be a correct term? No, it isn't—by the X-ray process?

A. By diffraction method, yes.

Q. Diffraction method.

A. Well, as I said yesterday, we did about one hundred and twenty-five lead oxalate experiments, and, of course, we have had a large number of samples under varying conditions from Shimadzu mills in this country and from Japan, and numerous experiments which we ourselves did with these materials.

Q. When were those diffraction patterns that are shown in Plaintiffs' Exhibit 21 made?

A. Those were made at different times, all of which, the dates of which are indicated on the films in evidence. Outside of the three fractionated films there and that one in which there was moistening with water, those were all made in the summer and early fall of 1934. The others, of course, have been made just two or three weeks ago.

Q. These were made, including 9, 10 and 11, were made in 1934?

A. 1935.

Q. 1935?

A. Yes.

Q. And all the others were made in 1934?

A. Yes, with one, possibly one exception, that one moistening with water was just recently.

Q. That is number 7, which is number 3 after moistening with water and drying in a vacuum?

A. That is right.

Q. Sot that was made recently?

A. Yes.

Q. Perhaps August, or early September.—

A. Yes.

Q. —1935? Dr. Clark, I wonder if you will be good enough to help me out a little bit with this statement in Dr. Wilson's report? At the bottom of column two on next to the last page of the report I read this:

"Dr. Clark on the other hand states that—

MR. MORRIS: Has Your Honor that?

THE COURT: Yes.

MR. MORRIS: It is next to the last page, the last paragraph on the next to the last page.

THE COURT: Yes.

BY MR. MORRIS:

Q. "Dr. Clark on the other hand states that he has found lines in the X-ray spectra of these samples, some of theme quite well marked, which do not correspond to the lines of either metallic lead or tetragonial litharge. On the basis of his observations, any extended discussion of which will be omitted at the present time, he concludes that lead suboxide (Pb_2O) is present in this mixture and assigns to it, on the basis of his calculations, the cuprite structure."

Have you arrived at any different conclusion since that informaion was given by you to Dr. Wilson?

A. No.

Q. What is the cuprite structure?

A. Cuprite structure is that which corresponds to the cubic structure corresponding to Cu_2O, represented in the lattice picture which we presented yesterday in which there are face centered cubic metal atoms with oxygens interspersed.

Q. What do you mean by face centered, Doctor?

A. The unit of crystal structure of lead is—metallic lead, that is, the last subject unit of the crystal is a small cube, with an atom of lead at each corner and one in the center of each face.

THE COURT: Judge, are you going to read him the balance of this paragraph later on?

MR. MORRIS: I can do it now; be glad to do it.

THE COURT: Well, I was rather interested to see whether that still represents—because tha is apparently—

MR. MORRIS: Well, suppose I do it now,—

THE COURT: Well, all right.

MR. MORRIS: —or will Your Honor do it?

THE COURT: No, you go ahead.

MR. MORRIS: Will Your Honor do it?

BY THE COURT:

Q. Well, I just want to go ahead with this statement. After "cuprite structure" Dr. Wilson goes on to say:

"However, he believes that the suboxide can not exist in the pure state but is always in equilibrium with metallic lead and litharge according to the equation Pb_2O equal $PbO+Pb$."

That is not "equal", that is the other mark; what do you call the other mark?

A. The arrow marks, you mean?

Q. Yes.

A. Equilibrium.

Q. Equilbiriam. Did you give that information to Dr. Wilson at that time, at the time he made that report?

A. Yes.

Q. Does that still represent your—

A. Yes.

Q. You say it cannot exist in the pure state. Am I off—

A. Well, that— that was the information given to him at the time of this—when this report was written. Of course, the subsequent fractionation, preparation of a phase nearly pure, is a very late development.

Q. Well, I mean, does that—

A. Yes.

Q. —sentence that I just read represent your views today? I thought, I thought that you had come to the conclusion that it could and did, through your fractionation, exist in the pure state.

A. Yes, that was exactly right. Of course, the intimation, it seems to me, here, or the implication, which is still correct, is that lead suboxide as prepared in various chemical processes such as with lead balls and air, or from lead oxalate, does not exist in a pure state.

Q. It can only be—only be gotten by fractionation?

A. Yes.

Q. You do say that you get it in a pure state by fractionation, is that it?

A. Practically pure, yes.

Q. Practically, pure.

THE COURT: All right, Judge.

By MR. MORRIS:

Q. Then, why cannot it be proved and demon-

strated by chemical process as well as by the lines of the X-ray photograms?

A. I beg your pardon, Judge Morris, will you please ask that—

Q. I will withdraw it. What samples did you use in making spectograms 9, 10 and 11 on Plaintiffs' Exhibit 21?

A. What samples did I use?

Q. Yes, where did you get your samples?

A. Those are, those are—9, 10 and 11 are the fine fraction, is that it?

Q. That is right, I will show them to you.

(Plaintiffs' Exhibit 21 was shown to the witness.)

A. Those samples were prepared by us from the non-settling fraction in a super-centrifuge from original mill oxides as designated.

By Mr. Morris:

Q. Did you run the centrifuge yourself?

A. I did.

Q. Did you prepare it for this test?

A. I did.

Q. Did you make the preparation of the liquids which went into—

A. Yes.

Q. —these tests? You did that personally?

A. I did.

Q. Did you do your own measurements afterwards?

A. I did.

Q. So that what preparation was there to be made for the machine before the tests were made?

A. Simply a dispersion of the material in the liquid medium, which, of course, was carefully done,

out of contact with air, and this suspension prepared by—in that way was then subjected to a super-centrifuge. This super-centrifuge belongs to the Geological Survey of the State of Illinois, it is not a part of the chemistry department's equipment, and their expert, of course, ran the machine.

Q. What oil did you use?

A. This was a low boiling petroleum ether.

Q. Low boiling petroleum ether?

A. Yes.

Q. What would be the chemical composition of that, generally speaking?

A. Well, that is essentially pure hydrocarbons.

Q. Pure hydrocarbons?

A. Yes.

Q. From which all air had been eliminated?

A. Yes.

Q. Where did you keep your samples that you had from 1934 until August, 1935?

A. They have been kept sealed in the dark in my files, very carefully sealed, with stoppers, just as received.

Q. What kind of stoppers did you use?

A. The stoppers received from Dr. Wilson were, if I remember rightly, paraffin stoppers, paraffin coated.

Q. Did you take your samples from the same container that you had used in making your examinations in 1934, or a different samp" ?

A. From the same sample exactly.

Q. The sample, then, that you used in 1935 for making these tests then had been opened?

A. It had been opened long enough to—in 1934—to remove a small quantity for the X-ray examination.

Q. And what was the size of the container from which you took the sample?

A. These were sent to us in test tubes approximately a foot long. The samples were obtained at the mill, and in order to be kept dry were placed over P_2O_5, phosphorus pentoxide, with a suitable cotton or porous plug.

Q. Doctor, you are talking about the powdered sample, now, or the ball?

A. Well, powder sample; and the ball, of course, was shipped in a sealed—one ball we received was shipped in a sealed tin can, the other was shipped in a glass vessel in which there was P_2O_5, a glass wall.

Q. No, but I didn't know that, my difficulty is that I didn't now any pentoxide, if that is what it was, was used in connection with the powdered samples, I thought they were sent sealed and that substance was used only in the cans in which the balls were placed. Am I wrong about that?

A. These—these samples which we discussed yesterday all have—all are sealed oxer P_2O_5, in order to be kept very dry.

Q. I see. Have you yet told me, Dr. Clark, whether you have a list of the interplanar spacings for all of the materials you have investigated by the powder method of X-ray analysis?

A. They are given on the—

Q. The books that you are going to produce?

A. Yes, and they are given on the sheet which you have.

Q. As to one sample?

A. One sample, yes.

Q. You have given me that, now, then, the others you are going to produce.

Have you calculated the so-called X-ray density of the so-called lead suboxide?

A. The X-ray density—let me see, we did that quite a long while ago.

Q. That is, you didn't do it with respect to your so-called isolated product of August, 1935?

A. No, we are expecting to do that. We haven't done that as yet.

Q. What might that tell you affirmatively or negatively?

A. That information I think would be very valuable, because if we do assume for the moment that the substance Pb_2O crystallizes in a cubic lattice, of course, it is eas to calculate its ideal density from the size of its unit cube.

Q. Then, as I understand it, your stated conclution of the separate existence of the compound Pb_2O is still based on some assumptions?

A. No, I am just—I am simply stating that you are assuming it.

Q. I am afraid we are at cross purposes for the moment, then. Would you be able to definitely conclude that, even in your own opinion, that this centrifuge product is Pb_2O, unless you based it spon the asshmption thta it has a cuprite structure?

A. Well, the cuprite structure is one factor, it is a combination of behavior of the results of these other experiments, which leads me to conclude in my own mind, at least, that there is every reason—that is, perfectly reasonable that such a substance exists and that such a substance is in this centrifuge sample in essentially pure form.

Q. But I am still at a loss, Dr. Clark, that if nobody has determined from an isolated Pb_2O product that it has a cuprite structure, I still don't understand why you can give to this hitherto unisolated and undiscovered product, why you can assign to it the cuprite structure.

A. Well, it does have the cuprite structure.

Q. That is, of something which has never been found before, you can say that it has a cuprite structure, or are you speaking of the stuff that you analyzed with the X-ray spectogram?

A. Well, the spectogram which we produced—

Q. Shows a—

A. —shows a pattern of a cuprite-like type of substance, plus additional lines of another substance.

Q. Yes.

A. Unidentified.

Q. But I am still lost, Doctor, and if you will just have a little patience with me, because I don't know this art as you do, but with something that you have never isolated, and no man before you had ever isolated,—withdraw that, and let me try it this way,—so far as you know Pb_2O had never been isolated prior to August, 1935. Am I right in that assumpaion?

A. Ferrari claimed its isolation.

Q. Well, I gathered this morning in answer to His Honor's questions you claim the discovery in some way. Now, am I wrong about that?

A. No, that is right, Ferrari—Ferrari's specimen also contained lines of metallic lead.

Q. So Ferrari didn't have it isolated?

A. No.

Q. So, not having it isolated, was he able to determine definitely what it was?

A. Of course, he—he found, of course, the first thing that he did was to find all lines of metallic lead which could be subtracted from a total composite of lines. The residue of lines upon analysis with various careful analysis with quadratic equations, and so on, fit a particular type of structure.

Q. Yes.

A. To which he assigned, and which was a cuprite structure.

Q. Yes.

A. Or a cuprite-like type of structure.

Q. Yes.

A. He simply stated upon the basis of—

Q. Assumption?

A. Of previous knowledge in the literature, that this material was lead suboxide, because it certainly was not PbO.

Q. Have you done any more?

A. We have prepared or attempted to prepare, I think we have prepared by the fractionation method a sample free from that.

Q. Free from what?

A. Free from metallic lead and from PbO, essentially.

Q. Now, I didn't—

A. And which gives, it is perfectly true, a double—a mixed sepctrum, there is some other substance there present in small amount which we have not been able to identify.

Q. Now, I didn't understand that you were able to say that you had produced this free from metallic lead, and do you now say so?

A. This super-centrifuge fraction is essentially free from metallic lead.

Q. What do you mean by "essentially"?

A. It gives no measurable evidence on an X-ray fraction pattern of characteristic lead lines, that is, the whole pattern.

Q. You are speaking from a spectogram and not from the chemical analysis?

A. Yes.

Q. Well, I still am a little in the dark, Dr. Clark, of why when Farrari assigned to this a cuprite struc-

ture—withdraw that—this is what I don't understand, why if the lead suboxide had not been isolated prior to Ferrari that he, even if he found under his spectogram, under his X-ray treatment a product that had the cuprite structure, I don't understand how he could say or how you could say that the cuprite structure which was found by each of you was metallic lead?

A. Was—

Q. Was Pb_2O.

A. In order to answer that question, of course, you must combine with this observation that you have a cuprite structure a certain new chemical substance, certain interplanar spacing, certain lattice constant, and so forth, combined with that the behavior of the sample. In chemistry when we cannot deal with a static system and we are unable to get enough information from the system as it stands we very frequently resort to a study of change which takes place. Such he has done and such I have done.

Q. Do you depart from Ferrari? Don't you take the same assumptions in yours that Ferrari took in his in arriving at a conclusion that the name given to this, to a product by Berzelius, was indeed Pb_2O? Are there no assumptions unproved which lie at the foundation of that conclusion. That is a pretty broad question, Doctor.

A. Yes.

Q. And it is so broad that I would like to have it read to you.

(The question was repeated by the reporter, as follows:

"Q. Do you depart from Ferrari? Don't you take the same assumptions in yours that Ferrari took in his in arriving at a conclusion that the

name given to this, to a product by Berzelius, was indeed Pb_2O. Are there no assumptions unproved which lie at the foundation of that conclution? That is a pretty broad question, Doctor.")

A. Well, let me answer that first by way of analogy. Suppose that, suppose that a man discovers a new—a new chemical element, by magneto optical effect, or by an optical spectogram, or something of that sort. There are certain a priori predictions that can be made, certain laws which will govern, which will assist in setting up certain predictions as to the identification of such new chemical element, previously unknown, whose properties are unknown except by reference to a periodic table, or something of that kind. When such a prediction is made, in which calculation of a spectrum line is made, and upon a spectogram a line like that appears, chemists in general accept that as evidence of—based up on the possibilities of departure from chemical laws, having to take that into consideration, of course, obviously, they accept that as evidence, at least, the primary evidence that a new chemical element exists in this particular mixture.

Well, then, of course, it takes years with the new chemical compound before its properties are all known, it takes years. It must be isolated, it must be isolated not by one man, but by many men, it must be measured in every possible way, it must be studied from every chemical and physical point of view, until there is general agreement upon it.

By Mr. Morris:

Q. Now, has that period arrived with respect to the Pb_2O?

A. It has not, I am perfectly frank to say.

Q. Indeed, you and Ferrari are the only two people, so far as you know, in the X-ray field who have kindred conclusions, aren't you?

A. So far as I know; there are other X-ray papers, other X-ray men who have worked who produced patterns which are very proximate, for example, LeBlanc and Eberius, very rough patterns, from which they conclude the non-existence of any large amounts of Pb_2O, but by looking at their line drawing I don't think that anyone would care to place very much reliance in that type of evidence.

Q. But their standing in the scientific field is good, bad or indifferent?

A. Good, very good.

Q. Now, there are others, am I right about Derbyshire, or was he over in the chemical field, how many others have tried to follow Ferrari and couldn't?

A. Let me see, there is LeBlanc, and Eberius, there have been two or three other papers by German and French people.

Q. About a half a dozen, aren't there?

A. Yes, something like that; I don't remember the names at the moment.

Q. Do you know whether Ferrari was ever repeated or attempted to repeat his experiment?

A. I have had some correspondence with Ferrari two or three years ago. Just as he has, just as we have found and he has found from his oxalate experiment, it is exceedingly difficult to reproduce, because of the extreme sensitiveness of the process to such a quantity of lead suboxide as he claimed in his first experiment but he has by no means dismissed or accepted—he has by no means dismissed the fact that Pb_2O does exist or is formed.

Q. That is, that was his conclusion, and he is standing by it?

A. He still stands with it, yes.

Q. But that doesn't tell me whether he has told you as to whether he has repeated his experiment, subjected it to another test treatment at his own hands.

A. Well, he hasn't definitely enough stated so that I could make any conclusion.

Q. Then if I understand you aright, you have not been able, even experimentally, to determine so far the actual density of this so-called lead suboxide.

A. It has not yet been done.

Q. Then if I understand you aright, also, you do not now know that your calculated value fits in with the lead suboxide picture, do you?

A. No, we don't know, that is just another step that has to be done.

Q. So would you expect, Dr. Clark, as a scientist that the scientists of the world would in large measure accept a conclusion now that lead suboxide exists, until those assumptions which we have been dealing with, and lack of data, have been determined?

A. Well, I am perfectly frank to say that I should not want to publish a paper until these further measurements have been made, until we get molecular weight determination and various other things. We can say, I think it can be, could be accepted—

Q. Do you think a person's business should be perhaps—

THE COURT: Perhaps he was going to finish that.

By THE COURT:

Q. You can say something: what is that?

A. I say I can say from X-ray examination,

from the chemical measurements we have made, chemical studies, and the microscopic studies, that there is a new substance, a third and different substance, corresponding not to lead and not to lead oxide, PbO, which logically corresponds—which is an oxide—which logically corresponds to the type of thing in which oxygen enters a lead lattice, which is easily oxidized to a known substance in air, which has a different refractive index from PbO or metallic lead, which has a different, entirely different microscopical properties, which produces a different X-ray pattern, which is common to all of these substances, fractionated and un-fractionated.

By Mr. Morris:

Q. Then would this statement be about where you stand at the present time, Dr. Clark, or not, that from your recent calculations and experiments and observations, that you have found some evidence which would lead you, and you think should lead other scientists to be less surprised if it should be established that Pb_2O does exist as a chemical compound?

A. Why, I think that is a perfectly just statement.

Q. Let us pass to some more assumptions or established data, whichever you tell me they are, but I have been interested in the heat of reaction. That is, perhaps, one criterion, am I right in that?

A. The heat of reaction, may I ask, of what?

Q. Of this material which is under discussion, to wit, the Shimadzu product when subjected to treatment with acetic acid, for instance, would that be an endothermic or an exothermic reaction?

A. What is that again, lead oxide—

Q. When lead, PbO, is treated with acetic acid does the reaction give off heat—

A. Yes.

Q. — or absorb heat? Is it possible to measure in calories or otherwise the heat that is given off by such reaction?

A. Why, certainly.

Q. Did you measure the heat that was given off by your isolated Pb_2O?

A. We haven't yet made calorimetric measurements.

Q. So, again, your testimony so far has been given without complete check of all the things which should be applied in determining the existence or non-existence of Pb_2O?

A. Calorimetric measurements and other things not yet completed are all valuable in adding to the complete and final story.

Q. Or subtracting?

A. Yes, or subtracting.

Q. But the heat of reaction has been measured, or, haven't some of the people, prior people, who have been studying this fluid measured or said that they have measured that heat of reaction?

A. I think I remember so, yes.

Q. Maybe Tanatar was one?

A. Yes.

Q. Have you based your conclusions so far given at all on anything that Tanatar did or said?

A. Tanatar's work, it seems to me, was a very interesting piece of work, 1901, possibly the most accurate measurements of heats of reaction and things of that sort up to his time in this field. Of course, he found that depending upon the way in which the preparation was made he would get widely different results, he could produce a product in which lead would not be extracted by mercury.

Q. I am wondering if Pb_2O is such a fugitive compound, even assuming its existence, if Tanatar had not been able to isolate it, how he knew that he was taking the heat of reaction of Pb_2O. Can you tell me?

A. Well, his, I think, conclusion was based upon the fact that a sample prepared in which, if I remember rightly, the air was, or the stream of carbon dioxide gas was passed over his product continuously, so as to remove carbon monoxide, his assumption was, I think that is about all that could be said. the assumption was that one of these products, black in color, from which lead was not extracted by mercury, gave a certain heat of reaction. When, however, he made the product by another method, another temperature—not by another method, but under different conditions, getting a more olive green substance, he did get a different heat of reaction. If I remember right he subtracted one from the other.

Of course, his work has been criticized, probably justly, because of the possibility of formation of carbonate in his CO_2 atmosphere.

Q. That is as I understood it, so you would not want to stake your reputation, would you, Dr. Clark —

A. Oh.—

Q. —on saying that Tanatar had Pb_2O?

A. — I don't, I am not.

Q. I thought not. Well, there is another man who gave us something about calories, didn't he, and heat of reaction, wasn't that Hershkowitsch, or something like that, name?

A. Hershkowitsch, in 1921, yes, sir.

Q. Would you care to make any different statement with regard to what he did than with regard, you just made with regard to Tanatar?

A. Well, his conclusion, of course, was—he got a heat of reaction, that is, difference of heat of reaction between so-called lead suboxide and lead oxide, which is different in sign. He ascribed that not to erroneous measurements upon the part of Tanatar, but simply, probably, that Tanatar's product was contaminated. Those, of course, those, of course, I don't have in mind. I have a translation of the—

Q. Well, all these men who in prior years published their experiments or the result of that were using Berzelius, so-called Berzelius suboxide, weren't they?

A. If you will permit me to make a slight change, we have been blaming Berzelius for a good any things. He was a great man. As a matter of fact, due just inadvertently to faulty memory yesterday, the first man who really did a comprehensive oxalate experiment was Boussingault. Berzelius was the man who first mentioned lead suboxide by the rusting or the dulling of metallic lead in air.

Q. The man prior to Berzelius was what time, Boussingault, whatever his name is?

A. Boussingault, yes.

Q. What was his period?

A. Well, he was later than Berzelius. His was, I believe, in 1850, around, something like that.

Q. Berzelius was 1830—

A. Yes.

Q. — to 1840, something like that, so that notwithstanding Pb_2O has been discussed by scientists for a hundred years it has not yet been determined that such a compound exists?

A. Well, I will—

Q. Further than you said in your answer.

A. I am frank to say that I started from zero,—

Q. I see:

A. — on this.

Q. There is one thing that troubles me, it is just a little departure from the line of questioning that was going on now. I gathered from your testimony that Pb_2O if it exists is an exceedingly fugitive compound. I assume I am right in that?

A. At elevated temperatures and in the presence of oxidizing materials.

Q. Yes. Would you care to assign to those temperatures some order, or attempt to? I don't want specific Fahrenheit degrees, but approximately.

A. I can only mention some actual experiments, that is, the date of actual experiments, for example, 310 degrees centigrade is the—certain heat, of course, is required to decompose, let us say, lead oxalate, now, 310 degrees very, very sensitively is the temperature at which an optimum amount of this compound is formed, 311, or 12, even 15, 315 degrees immediately, instantly lowers, from our own experiments, the quantity which we found. Of course, lower temperatures than 310 degrees centigrade does not permit complete decomposition of the lead oxalate.

Q. Then you trouble me even more than I thought that I was troubled, if it is a fugitive compound, only about 310 degrees centigrade, I am wondering why the Shimadzu product could not and should not have in it the ninety-three to ninety-seven per cent. Pb_2O, if it was formed in the mill.

A. It is, it is fugitive at, dissociates at lower temperatures than 310. I am simply quoting one experiment—

Q. Yes.

A. — that was—at 100 degrees or 150 degrees below that it is still dissociated easily.

Q. Then I am wondering, on the other hand, how it could be possible, since it is so fugitive, for you to say that there can be even in the Shimadzu process any such percentage at any moment of ninety-three to ninety-seven per cent., or even anywhere in that order of socalled Pb_2O in the mill.

A. What we mean, what is indicated by that statement is this, that ninety-three per cent., or ninety per cent. of the product which is produced goes through a suboxide stage, if we simply integrate throughout all the balls and through all the mill, and all that sort of thing.

Q. Then you do not mean, as I understood you to mean, that at any given moment in the mill ninety-three per cent. of the material in there is in the suboxide state?

A. Ninety-three per cent. of suboxide as such is not there, it is going through that stage.

Q. I misunderstood your testimony.

A. Yes.

Q. Then there is another thing about which I have some question, Dr. Clark, and that is, if I understand you aright, you measured only the lead in your—in the centrifuge product, so far as you have told me you did nothing with the residue. Am I right?

A. That has not yet been done, no, sir.

Q. Then how, Dr. Clark, can you assign to your centrifuge product any oxygen at all?

A. For the very good reason, it seems to me, that when this substance is heated in vacuum it very distinctly forms metallic lead and PbO, both of which can be seen and identified.

Q. And then you measured the proportions of that?

A. That has not been done quantitatively.

Q. So that would be another test—

A. It will.

Q. — that will be essential to a sound conclusion?

A. Absolutely, there should be, of course, a ratio of one to one.

Q. Do you base any of your conclusions which you have told us here with respect to your centrifuge product upon the intensity of your diffraction lines?

A. You mean the amount of material in the mixture, or what? It has been—

Q. Well, I wonder if my term "intensity of diffraction lines" means anything. I wonder if I am using that properly.

A. We have used the intensity of the diffraction lines, of course, in these mixtures, in these microphotometer curves, to indicate the approximate composition of any mixture. Now, the intensities of these lines are characteristic, of course, not only of the quantity of material, but there is a certain type or a certain distribution of intensities in the whole pattern, from one line to the other, which characterizes. In other words, some atomic planes, or molecular planes are more thickly populated, for example, and produce by interference of secondary X-rays a more intense line than other planes will.

Q. If I may get a free lecture on one phase of this X-ray experiment, may I ask this, whether there are not primarily two things involved in your diffraction pattern, one, your lines, second, the intensity of those lines?

A. The intensity of the line when you come to a final, unique analysis in terms of space groups, exact atomic positions, that is the method, the intensities are utilized, that is, rough, roughing, roughed values

of intensities are utilized to place exactly in space oxygen atoms and lead atoms and things of that kind.

Q. That is, intensity?

A. Intensity.

Q. Well, then, the intensity of your diffraction lines, does or does it not play an important part in the conclusion?

A. It does play a part.

Q. Would you mind telling me, Doctor, please, what conditions affected diffracting power of a powdered crystal?

A. Well, I am not sure I know just what you mean. Of course, the diffracting power of a crystal—

Q. Well,—

A. — depends upon its structure.

Q. Well, a crystal that is found in a powder of the minute size of that here in question.

A. There are some, what we call extinction effects, effects, distinct effects upon the intensities observed in a powder spectogram.

Q. And they are—

A. Well, we may have—we may have effects, in order finally, in order finally to analyze the situation we must know the laws of reflection by imperfect crystals, because most of these crystals are imperfect, the laws of reflection by imperfect crystals of X-ray waves; we must know what we call the structure factor. There are corrections introduced for the calculation of an absolute intensity for structure factor depending upon temperature, polarization, overlapping of lines, involving, of course, always the fact that we may have a fairly constant, not exactly constant, because it isn't a linear line, but a curve, atomatic structure affected, due to any one particular

kind of atom. That is a highly technical subject, of course, but one which unique analysis must be understood and calculations must be made. Those calulations are made nowadays primarily upon the basis of Fourier analysis.

Q. What kind of analysis?

A. Mathematical Fourier series analysis.

Q. Oh, yes, yes. I was wondering whether particle size is a condition which might affect in some measure the diffracting power of a crystal found in such powder as that we are dealing with here.

A. Yes, there is an effect, a differential effect upon different lines, not only that, not only the particle size, but the particle shape, particle orientation.

Q. Study of strain, for instance?

A. Study of strain, yes.

Q. What affects the relative blackness of two lines on a photograph?

A. Well, that question has many answers, whether you refer to laws of photographic blackening, their logarithmic darkening, or what laws.

Q. Well, I am just wondering what it is, that is my—I am not referring to any specific thing, but we get lines on Exhibit 21, or on the photograms, diffraction patterns, which are shown here, and some lines, as I take it, are blacker than others. It is not so well shown there as it would be on the—

A. Negative.

Q. On the negative.

A. Yes, that is right.

Q. Have you some of those negatives here?

(A negative was shown to the Court.)

Mr. Morris: You can see some of those lines.

By Mr. Morris:

Q. What causes some of those lines to be blacker than others, and what affects the relative blackness of the two lines on such a film?

A. The structure of the crystal, of course, the arrangement of planes, the number of atoms upon the planes, as I said, the intensity, the intensity roughly measured by blackening is a function of all of these things.

Q. That is, the intensity of your diffraction beam would affect the relative blackness,—

A. Yes.

Q. — or the blackness of your line?

A. Yes, that would affect, that is, the intensity of the X-ray beam with respect to, also, the time of exposure.

Q. The time of exposure; were all your films exposed for the same length of time?

A. Essentially the same, one hour.

Q. One hour in your new device?

A. Yes.

Q. Now, I didn't get, Dr. Clark, exactly what you meant by "essentially", you mean there is a possible time error of a minute, or something like that?

A. Well, I simply refer—I was just thinking of the entire composite of all experiments. In any comparative studies, of course, the time is very accurately kept to the same time, one hour.

Q. And all these that are shown on Exhibit 21 were, within some minor degree of error, one hour?

A. Yes.

Q. Photographic films of the same character?

A. Exactly.

Q. Developed under the same conditions?

A. Exactly the same conditions.

Q. Identical conditions?

A. Same temperatures, same length of time in the developer.

THE COURT: I think we will recess for ten minutes.

(Recess at 3.45 o'clock P. M.)

AFTER RECESS.

THE COURT: Judge, do you think you can conclude your cross-examination this afternoon?

MR. MORRIS: I have concluded, if Your Honor please.

GEORGE L. CLARK, recalled.

Re-direct-examination.

BY MR. WHITCOMB:

Q. Dr. Clark, when we started in these processes, you started with pure lead?

THE COURT: Started what?

MR. WHITCOMB: With the little lumps, themselves.

THE COURT: Oh, you mean the process of the pattern?

MR. WHITCOMB: Yes.

THE COURT: Oh, I thought you meant his examination.

THE WITNESS: Yes, metallic lead, pure, at least, in the ordinary sense.

By MR. WHITCOMB:

Q. What degree do you mean?

A. The metallic changes used are very nearly spectroscopically pure. Spectroscopically pure means very small, within the thousandth or ten-thousandth per cent.

Q. Then you use air?

A. Use air.

Q. What about that in connection with other than when you know you are dealing with?

A. I don't quite understand you.

Q. Do you know all the elements to the nth degree of accuracy as to what the air constituencies are, such as oxygen, hydrogen?

A. It is originally nitrogen and a few minute amounts of the rare gases of the atmosphere: possibly a little humidity, carbon dioxide and whatever is in the air.

Q. Then with these processes you started with reasonably known substance?

A. Exactly.

Q. Is that what you mean, you used that as a part in making the conclusions you have made on behalf of the plaintiffs in this case?

A. Yes. Lead and oxygen are the two things which react to each other.

Q. Then when you have made these X-ray examinations which you made on a certain number of examinations of samples, a large number of those, up until you used the centrifuge machine, and then several of those, and your conclusion was you found lead suboxide?

A. That is the conclusion, yes, sir.

Q. These added things, these further tests that

you made, desire to make, would they in any way affect your conclusion as to the existence of the suboxide?

A. Of course, I believe in the existence of suboxide upon the basis of the experiments we have performed so far. It is simply for scientific purposes; it is, of course, very desirable to proceed in testing this material by these other methods which we have not had. Unfortunately for the purposes of our testimony, this centrifuge and these other experiments have been so recent that they simply could not be completed.

Q. Then is there any doubt in your mind about the existence of this?

A. I have no doubt myself.

Q. Do you feel just as positive now as you did in your direct-examination?

A. Yes, that is a feeling I have, that suboxide is formed on the basis of the information that I have myself.

MR. WHITCOMB: That is all.

(Adjourned until Monday, September 30, 1933, at eleven o'clock A. M.)

GEORGE LANE KYLE was called as a witness on behalf of plaintiffs, and having been first duly sworn, testified as follows:

Direct-examination.

By MR. WHITCOMB:

I am from Niagara Falls, New York. My busi-

ness is electrical engineer of the USL Battery Corporation, Niagara Falls. I have been connected with that company since 1915 in the capacity of electrical engineer in charge of the battery testing laboratories, research. Broadly, the business of the USL Corporation is that of manufacturer of storage batteries for all purposes, amongst others, for automobiles. Some large manufacturers which are users of original equipment are the Ford Motor Company, Nash, Auburn, and several others. The annual output is approximately a million and a half batteries for automotive purposes in normal times. As to my specific duties, I am in charge of the testing laboratories. Directly under my control is the testing of all the batteries in the plant at Niagara Falls, that is completed batteries.

Our storage batteries are usually sold under specifications of the original car manufacturer. We have to test the batteries to meet these specifications. I am acquainted with the process of manufacture of a storage battery and with the materials. At USL, we start with lead powder, oxygenated lead powder. That is carried through to what we call the mixing department. In the mixing operation, the powder is put into a large mixer, which is similar to a dough mixer, and by the addition of certain other items, the paste is made into a consistency to be used in the grids of the plate. The powder is mixed with liquid to get a paste. The material is then pasted into the grid, which is the structure of the plate itself. This is done on a pasting machine. (The witness here produced sample grids.) The lattice grid work which you see in the horizontal and vertical fine wires is the grid. The material that has the grayish color there is the paste. That is applied on the pasting machine to one of those grids, separated

at that time. In the pasting machines, the paste is applied into the interstices between the wires on the grid. Then the plate comes off the end of the pasting machine and is then ready for the drying operation or any other process that we might designate, so that it can be handled for its forming process or into the burning of the group itself. The group is the series of plates that are burned together by a strap. The number of plates determines the capacity of the battery. By "burned together", I mean that the plates are placed in a rack with their proper spacing, with the proper post strap, and by a lead-burning operation, the strap is burned across the top to make the electrical connection between the grid structure and the post strap. That is just a technical term, to connect the lug to the several plates. The group that I have here is the negative group. There is the positive group, which is the opposite polarity, which is burned in the same manner.

(Counsel for plaintiffs thereupon offered in evidence the negative group produced by the witness, which was received in evidence and marked Plaintiffs' Exhibit No. 32. Counsel also offered in evidence the positive plates produced by the witness, which were received in evidence and marked Plaintiffs' Exhibit No. 33.)

After the positive and negative groups are burned, that is, by the lead welding operation of the post strap, they are nested together with the positive plate between two of the negative plates, and placed between the plates of opposite polarity is a separator. (The witness here produced a separator.) It may be, as it is in this case, wood, to form the insulator between the positive and the negative plate. This particular sample is in a dry from. This particular

group of positive and negative plates requires a number of separators, but not in a treated condition.

(Counsel for plaintiffs thereupon offered in evidence as a group the separators for this cell, which were received in evidence and marked Plaintiffs' Exhibit No. 34.)

That group is then placed in its respective container and assembled with the covers and links or connecting straps are burned in position for any desired voltage that is required. There are three sells in that box. That is the popular form of automotive battery, which requires six volts, two volts to a cell.

(Counsel for plaintiffs thereupon offered in evidence the remainder of the battery as a unit, which was received in evidence and marked Plaintiffs' Exhibit No. 35.)

I stated that we started with oxygenated lead powder of some kind. USL has a mill operated under the Shimadzu patents. They have had that mill since about 1928. Before that, we purchased oxides; that is, powder in the form of an oxide. We call it oxides in the purchased material. It is the powder that we use for the mix in the mixer that corresponds to a dough mixer. I can best compare the powders, the oxides, we purchased with those that we are making in the mill by the results of our tests in the laboratory. I have some representing results when we used the purchased oxides. (The witness here produced the tests.) I have here curve 5087, dated October 30, 1930. It is a typical curve of a battery made with purchased oxides on the so-called USL life test. At that particular time in our laboratory we were comparing the batteries on a life test, which

consists of a charge and discharge periodically until the battery shows a predetermined capacity, at which point we examine it for failure. By predetermined capacity, I mean a lack of capacity. It is a comparative point at which we tear down all batteries for examination. We run it through these cycles. At the same time that we have a battery in the laboratory on this test, we place a battery in a service car, and compare the number of cycles with the months of service that is rendered in the field. This particular curve shows 130 cycles of life. At that point, we tore the battery down for examination. That is the curve.

(Counsel for plaintiffs thereupon offered in evidence the sheet produced by the witness, showing curve 5087, dated October 30, 1930, which was received in evidence and marked Plaintiffs' Exhibit No. 36.)

The battery will give service after that point, but that is the point at which we examine the batteries, so that we have them on the same basis for comparative purposes. This chart here is an examination of the battery at this point. That tells us the actual life cycles of the battery. From a comparison between this test and the field test and service conditions, we can tell how many cycles represent so much time in service. Every one of the manufacturers that we have supplied have specifications of their own as regards the life. There are slight variations between companies as to their life tests. This is our standard USL life test. We think that this is the best one, coupled with the field data that I have just mentioned, for determining how long a battery will last in the automobile.

(Counsel for plaintiffs thereupon offered in evidence the auxiliary test sheet entitled "Condition at End of Life Test, Dated 2-17-31", which was received in evidence and marked Plaintiffs' Exhibit No. 37.)

That sheet shows us the condition of shedding of the positive material, the condition of the negative plates, the condition of the sediment space, the condition of the separators. In the examination of the battery after we removed the three cells, after it had been on test, the positive group was carefully examined and the items shown on the positive plates were enumerated to show the condition of those plates. Thirty per cent. of the material was gone, that is, thirty per cent. of the lead paste has been eaten off "The upper quarter bare—no. Lower quarter bare—no. Bare in spots—yes—streaks." For a comparable sheet for a battery made with powder that came from the mills at the USL plant itself, I have curve No. 3612, together with a letter of October 14, which shows the first production formula that was put into our plant.

THE COURT: Well, may I ask, at this point, I suppose the purpose of all this is to show that the process which they say is the process of the patent affected a great improvement—

MR. WHITCOMB: Yes.

THE COURT: — in the material?

MR. WHITCOMB: Yes.

THE COURT: Well, now, the first question I have in mind is whether that is a disputed fact, and the second question is, how can we tell what material was being used before, where they got it from.—

MR. WHITCOMB: Well, he can explain.

THE COURT: — and how they were to know they were not getting an inferior material.

MR. WHITCOMB: Well, I think the witness will testify that they were raising the standards of their required specifications when they were purchasing—

THE COURT: Well, all right.

MR. WHITCOMB: — right along.

THE COURT: Yes.

MR. WHITCOMB: And then they shifted over to this material.

THE COURT: Well, all right, I suppose you will—

MR. WHITCOMB: Perhaps I overlooked that.

By MR. WHITCOMB:

Q. By the way, what are the conditions, what specifications did you insist upon, if any, in connection with the oxides when you purchased them? Give the Court some idea of that.

The witness, resuming, testified: For the best grade of oxides that was purchased at that time there were set specifications, in regard to the minimum amount of impurities allowed. Impurity was one of the important factors. They bought it from the Eagle Picher Lead Company, who are standard manufacturers of oxides. We bought these oxides in the form of a powder. Ordinary yellow and ordinary red oxide powder. They were made by furnace process, that is molten lead process, which is an entirely different process. We bought from a number

of different concerns. That was the standard practice for years up until the time we got the Shimadzu mill.

Referring to the sheet just produced, No. 3612, there are three separate tests of three separate batches, 180, 212 and 240 cycles.

THE COURT: As compared with 130—

MR. WHITCOMB: Yes.

THE COURT: — of the old.

THE WITNESS: Yes, sir.

The letter that was produced in connection with the sheet is from the assistant chemist, Mr. G. J. Monnin, to myself. It is an inter-departmental letter, which I got out of my files. It shows that this curve 3612 was used in production.

(The witness here read the letter into the record as follows:

"Mr. Reid has turned over to me blue-prints 3612, 3613, 3614, and 3615 which you submitted to him, and which represent life tests on various mixes of black oxides.

"We are now using in production the formula used in batch 2, represented by curve 3612. The formulae represented by the other curves have been discarded.

/s/ J. G. Monnin
Assistant Chemist."

(Counsel for plaintiffs thereupon offered in evidence USL Battery Corporation Test Sheet No. 3612, dated 10-1-30, produced by the witness, which was received in evidence and marked Plaintiffs' Exhibit No. 38.)

The witness, resuming, testified: These were typical production tests. They were not selected for the purpose of showing particularly good or particularly bad results.

(Counsel for plaintiffs thereupon offered in evidence as Plaintiffs' Exhibit No. 37(sic) the auxiliary sheet, No. 5087-1.)

The life curves show a higher number of cycles in the batteries manufactured with the product from our mill, as compared with the batteries manufactured from purchased powder. That was one of the reasons why we adopted it as regular production. In my experience and from examination of these batteries after the tests it is quite evident that the fineness of the material has quite a bearing on the life. It gives us a more consistent plate in capacity. We don't find any evidence of cracking in the original manufacturing, in either plate. We found a difference in flaking or cracking of the plates between the old oxides that were used and the Shimadzu mill powders. In the manufacture of the negative plates under the old process, we had considerable shrinkage of the material, which we have not experienced with the present mixture that we use. That resulted in a series of cracks in the material itself. That has a deleterious effect on the negative capacity of the battery. It affects the capacity. That was under the old process, whereas with the new we overcame that difficulty.

With the product from the mill, we have better control of the material. We have specifications, for the lead that we use in the mill, bought under what we call pure lead, but these specifications are much more rigid in regard to minimum quantities of impurities than the old oxides we purchased before

that time. I think that shows up in the performance I have indicated. We found that the material manufactured from the mill has a finer particle than the purchased oxides that we had at that time. It has some coarse as well, but it has the finer, and the finer is still finer than those that were purchased. That has the effect of giving up a more consistent paste for pasting of the plates. That, in turn, results in longer life, we find through our tests, by less shedding of the active material on the positive plates. That less shedding is one of the points brought out in the sheet which showed what happened to the battery after it had failed. The new oxides tend to avoid that to a certain extent, in my opinion. We purchased both red lead and ordinary litharge. There was no metallic lead in the powders we purchased. The powders made in the mill of the USL plant contain finely divided lead particles, lead oxide and suboxide of lead. The operations of the mill itself in the USL plant are not directly under my supervision, but I have been in the department when the mill was being operated. The mill, as placed in the USL factory, is a rotating drum into which are fed small lead pieces. The first installation came from Japan. I have no blue-prints or charts of the mill. We can get them for you. As I said before, we have a rotating drum into which are fed small lead particles at one end and through which a blast of air is blown. The particles that are fed in come off our chipping machine approximately an inch square. The blast of air carries the lead particles through, up into a bag house and into a receiver or collector at the other end. As to the controls or charts which indicate what is going on, I have inspected the charts on the front of the temperature control board. I have never noticed the chart in regard to the air.

They have a control of the air, that is, the pressure. My inspection has been such that I have only noticed the temperature controls. There is a forced draft, however. I have noticed that by going through and the fan blowing through the drum.

When I said that that chart (Plaintiffs' Exhibits 13, 14 and 15) was not a picture of the installation at USL, I meant as to certain design details of the machine itself, that is, from the outer description of the machine.

With respect to the cost of operation of the mill and the finished product against the cost of purchased litharge or lead particles, we have less cost with the present mill product than in purchasing the material from the outside. From my experience with this material, I would not recommend going back to the purchased oxides.

Cross-examination.

By Mr. Morris:

The products manufactured in the mill which I described are better for battery purposes than the old purchased oxides, due to the fineness of the material, which we have experienced through the examination of our batteries on these tests, and the purity of the material and the control we have over the purity of the material. We buy the purest grade of lead on the market for the mill at the present time, so that the reason for greater purity is the greater purity of the product that is put into the mill. They cannot manufacture the same purity. If we had a mill or a furnace to make it by the old process, we could buy just as pure initial that goes into the furnace as we wanted. That would be the same degree of purity. But the finished product that

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we buy in the oxides would not be of the same degree as we get out of our mill. If we were operating the thing from the beginning to end, the item of cost would come in. It would be true that, if we owned both kinds of processes, we could get just as pure a product out of one as the other. Assuming equal purity in the initial charge of lead, the one fact that makes a difference in the two materials is the fineness, the increased fineness of the present product over the fineness of the old.

In our mill, the exterior of the drum is closed. The drum is cylindrical. It is not of the type of the Hardinge mill, that is, a cone shape, but is cylindrical. I am an engineer and have been manufacturing batteries since 1915. (A model of the Hardinge type mill was shown to the witness.) Our mill is not in that form, but is cylindrical, with the intake orifice in one trunion and the exit or discharge orifice in the other trunion. We blow the powder out of our mill. I am not exactly familiar with the operation of the mill, but I would say that we blow it out. If we didn't blow it out, it might be carried out through some mechanical means. It would not run out of our mill by gravity.

Prior to taking a license under the Shimadzu patents, we purchased yellow litharge and red lead. We did not specify to the manufacturer that they should be mixed in certain proportions. We bought them under their terms, designated in that particular.

By The Court:

Q. Pardon me, litharge and what?
A. Ordinary yellow litharge and red lead.
Q. What is the difference?

By Mr. Morris:

Q. You mean Pb_3O_4, or do you mean the tetragonal form of litharge?

A. No, Pb_3O_4.

The Court: Now, wait a minute,—

Mr. Morris: I think I can straighten you out in just a moment.

The Court: All right.

Mr. Morris: Litharge, which is PbO, crystallizes in at least two forms,—

The Court: Yes.

Mr. Morris: — the tetragonal,—

The Court: I remember that.

Mr. Morris: — which is reddish,—

The Court: Yes.

Mr. Morris: — and the yellow, which is orthorhombic.

The Court: These are just the two forms of litharge?

Mr. Morris: This is all litharge.

The Witness: This is the purchased material.

By The Court:

Q. I know, but you spoke of litharge and red lead as though they were different things.

A. They are.

Mr. Whitcomb: They are, there is a third one called red lead. That is Pb_3O_4, another form

THE COURT: It is Pb_3O_4, all right.

MR. MORRIS: What I was asking the witness whether he meant the tetragonal litha[illegible], which is PbO, the same as the yellow litharge, or Pb_3O_4.

THE COURT: He says he means the Pb_3O_4.

MR. MORRIS: I see.

THE COURT: And the other is tetragonal litharge, the red lead you are speaking of is the Pb_3O_4, and the litharge you are speaking of is ordinary tetragonal litharge, is that right?

MR. MORRIS: Orthorhombic.

By THE COURT:

Q. Orthorhombic?
A. Orthorhombic.
Q. That is the yellow?
A. Orthorhombic is the yellow.

THE COURT: All right.

The witness, resuming, testifies: Prior to that, we did not have any free lead in our mixture, nothing except Pb_3O_4 and yellow PbO. I said that in this new mixture we have three ingredients, lead, finely powdered, lead oxide, and lead suboxide. I have been told that through the testimony of Dr. Clark. As to the source of information on which I make the statement that those are the three ingredients, we have determined that there is free lead in the powder itself. We have also determined the oxide of lead, and I take the statement in regard to the suboxide of lead from Dr. Clark. We determined that there was an oxide of lead present in our chemical laboratory. I am not a chemist. The information comes directly

from reports of our chemical laboratory to me. I know that there is such a compound as Pb_2O only through the testimony that has been given here by Dr. Clark.

The tests conducted are of typical production batteries, tests on production batteries taken from our production line. The particular tests referred to this morning in that curve cover one battery. That is, a typical test. That represents a fair average for a number of batteries in results both before and afterwards. In that one particular curve, 3612, if I recall the number right, designates three batteries, that is three different batches. I have said that the test of the old material gave 139 cycles of life. That was an average number of cycles for our old batteries made with the old material. I make that answer from our file referring to a great number of tests. I have examined those for the purpose of answering that question. Some of them ran as high as 155 cycles. I found none of the old powder that ran higher than 155 cycles in the tests that I examined. The tests were selected at random through the file. They were picked out at random from the files, on a fair basis to give a correct average. 3612 covers the three batches, on the first black oxide. This is the first test of black oxide and is lower than we are obtaining at the present time. All the three cycles, 180, 212 and 247, the highest is lower than our average result at the present time. We have some curves of the present batteries if you like to see them. One of them shows 272 cycles and 315. I will describe the details of a life test to which these respective batteries were subjected. In order to work it into laboratory hours, we take a discharge in the morning at eight-thirty until ten-thirty, at 24 g am-

peres, of an ordinary thirteen plate battery, which is rated on this curve as 102 amperes at the twenty-minute rate, of 90 ampere hours at the twenty hour rate; and from ten-thirty to twelve-thirty we charge at 27½ amperes; and from twelve-thirty until three we charge at a lower rate of 6 amperes; and from three o'clock until five, we discharge at 24½ amperes; and from five until eight-thirty next morning we charge again at 4½ amperes. That is merely to obtain two full cycles of discharge per day, which are represented on this curve as life cycles. That is continued from Monday morning until Saturday morning, until the battery shows failure. The fact or factor which determines the finish point of the test is the predetermined point of twelve minutes at the twenty minute rate of discharge. The old oxide plates lasted 130 cycles on that first curve submitted. You can't term the service life a designation of cycles, because you don't get a complete cycle. We do not subject every battery that is sent out to a life test before it goes out. The battery would be gone then. The batteries made under the old specifications at 130 cycles represents the battery that was on test in the laboratory. A comparative battery manufactured at the same time, under the same conditions, was placed in our service car for tests against that curve, and we found that approximately ten cycles represents one month of service in the field. The conditions of this test in comparison with the conditions of the test to which the present batteries are subjected are identically the same. This particular test is conducted on plates of three thirty-seconds of an inch in thickness. Both the 130 cycle test and the present test are identical in regard to thickness of plates. Both rated at 102 amperes.

In making our paste, we use some sulphuric acid and water. The sulphuric acid was diluted as it says in the recitation of the prior art in this patent. We used those same ingredients, that is, the same liquid, dilute sulphuric acid and water, in making our present plates. We didn't use anything else in 1915 and on until we got the Shimadzu license, with the exception that in a negative mix, inert material has been added, but that is for another reason. But so far as mixing of the paste is concerned, we had been using dilute sulphuric acid, or dilute sulphuric acid and water, since 1915. So far as we are concerned here, we used nothing else until we came to the Shimadzu product. There is a difference in the mixing of these same ingredients in order to make the Shimadzu product adaptable. I mean by that the length of time in your different mixing operations. But the same ingredients, dilute sulphuric acid and water, are used. The difference is in the mixing time. We had no free lead in our old product. The Shimadzu product is finer than the old product, as I stated. I do not have with me the dimensions of the powder in the old product. I can get it for you. I have seen the figures as to the dimensions of the powder in our present product, but I don't recall just what they are right now. I have both of those in our chemical laboratory. I did not make any measurements myself. I know about this only through my contact with the chemical laboratory. From things that I have received from our chemical laboratory, I have been advised that there are finer particles in our present product. To what extent they are finer I do not know. There is not such a difference in fineness that can be detected by feeling or looking at it. I will supply you with those figures or

withdraw the statement that one is finer than the other. I never subjected the old product of which we made plates to a test myself to ascertain whether there was the ordinary red lead, Pb_3O_4, and the yellow litharge, and no free lead. All I know about is what I have been advised.

Re-direct-examination.

By Mr. Whitcomb:

In the molten processes the finished product is not as pure as in the Shimadzu process, from the specifications we are furnished. In the furnacing processes, they pick up impurities. They used fifty per cent. Pb_3O_4 in the mix in the old type, in the positive plate only. The negative plate is straight yellow litharge. When you finish up in each case, you have lead peroxide on your positive and spongy lead on negative and finished form plates. That is, in the old method and the new Shimadzu method. In the finished negative plate, metallic lead is called spongy lead. It is just ordinary metallic lead. The significance of the term "spongy" is in the texture of the plate itself. The processing gives it that effect. That result is obtained from the powder in the formation of the plate itself. That breaks down into those two things by the actual current.

Re-cross-examination.

By Mr. Morris:

My personal knowledge as to the impurities in the process of manufacturing the old lead powder which we purchased from 1915 on to 1928, is through the chemical tests in our chemical laboratory. Our chemical tests did not tell us exactly when that im-

purity got into the product. I say that it got in during the process of manufacture and was not in the lead that was used in the manufacture of the lead powder sent to it through hearsay from the men that are in the manufacture themselves. I don't know, except through the process that we have gone through of the tests and all. Our chemical tests do not tell you that it got in during the process of manufacture. We knew it was there and inquiring from the manufacturer of the lead, which we had no control over, he stated that it was in there due to the manufacture. I didn't get the information from the result of our tests in the laboratory.

Re-direct-examination.

By Mr. Whitcomb:

I regard this point about the impurity as a reason why we would use the Shimadzu process in preference to buying the litharge.

William Cooper was called as a witness on behalf of plaintiffs and having been first duly sworn, testified as follows:

Direct-examination.

By Mr. Whitcomb:

I am employed at Niagara Falls with the USL Battery Company. I have been with the Electric Storage Battery Company in Philadelphia. I went to work for them in June 1923 and left there some time in the year 1930. At the time I left I was working in the gray oxide department. They made lead, just

called gray oxide. They have made it by the use of a mill. My duties there were as an operator of one of the mills. I was an operator for seven years. These mills were what is known as Hardinge mills, cyclone and bag, container bags, screen—lead balls were put in the mill. The cyclone drew the air through the mill from an air intake pipe. A fan actually drew the air. The fan was situated on the cyclone. The bags I refer to were situated in a container next to the cyclone and contained six bags for the purpose of catching—with respect to both cyclone and bag containers, the fan was situated on the same platform as the cyclone, that is, between the two. The air inlet pipe was situated on the feed end of the mill. By the feed end I mean the one where the balls are fed into the mill. I mentioned a screen. That is at the discharge end of the mill. The material obtained from the mills was put into drums under the discharge end of the mill. As the cyclone drew the air through the mill, a percentage of dust was deposited in the bag collectors. Under each feed of the cyclone and bag collectors was situated a drum which emptied into a drum. That was not the same drum that the finished product went into first. The size of the drum was the same. The dust or powder would be a very much finer powder. Three drums were situated. We got three different grades of fineness. At the time I left they did not use the three drums for each mill. But sometime prior to that they had used the three drums. Just at the time I left that had an automatic screw conveyor which carried the contents of the cyclone and bag containers back to the discharge drums at the discharge end of the mill. Then we combined the three drums into one drum. When we were using the three drums we would get perhaps one drum of material per shift from the

cyclone and from the bag containers. By shift, I mean eight hours. An average of twenty-four drums went to them from the main exit, that is, we got one drum from the cyclone and one from the bags. That would be two drums from the combined product of the cyclone and the bag containers, twenty-four from the discharge of the mill. The mill rotated (the witness here examined a drawing attached to Dr. Wilson's report, "Plaintiffs' Exhibit 20). That represents generally the type of mill I have been talking about. It shows the Hardinge mill, the cyclone and bag collectors. From 1923 up until the year 1926, the balls were fed into the feed end of the mill by hand. Eighty lead balls of four hundred pounds were discharged from the mill every twenty minutes. There were no changes for a number of years in the operation. When I left they were not still feeding by hand. They had a semi-automatic feed consisting of a ball elevated from a pit to an automatic chain running along the front of the mills which fed the balls into the mill. There was a chute attached in front of each mill into which the balls went, a square open chute. It was open clear up to the inlet of the drum of the mill. Beside the balls there were ball counters in the chute. The ball counters counted the balls as they went into the mill. There wasn't any sliding to interfere with the free passage of the balls at the time of the feeding semi-automatically. The balls being fed at the rate of twenty balls per five minutes over a period of twenty minutes and could hardly have a slide, normally. The balls were three inches in size. Every five minues twenty balls were fed, so that for every twenty minutes there was a total of eighty. I do not know the exact size of the fan of the mills at that time. Air could go in the Hardinge mill

through an inlet tube and also through the chute that I have described. The fan was running continuously while the mill was in operation. I do not know exactly the size of that chute. It was about four inches. The ball had about one inch play. In the cyclone the material that was collected dropped of its own accord down into the conveyor or into the earlier drums that we used. Part of the bag collectors between the bag and the screen shook or collapsed once every hour, or half hour so that considerable of the material that was collected in the bag collectors was shaken down by the shaking of the bags. In the early years, that was done by hand, later automatically the dust inside the drum in the mill would blow out at the feed end of the mill, through the outlet where the balls were fed into the mill. The dust came out of the mill. The mill was then full of dust and lead balls. When the bag shakers operated the effect was to blow some dust out of that end, although the feed was toward the other end. Of course, during the operation of the bag shaking, the fan was shut off. The little conical shaped cone dotted out after the outlet end of the Hardinge mill is a half inch mesh screen called a bell screen. It is cone shaped, the reverse of the picture. It should be arranged with the point towards the mouth of the mill. I can show that arrangement. (The witness here did so.) That little extension up in red is a little shaft that held the screen in place, clamped on the mouth of the mill. I think this drawing shows that particular screen headed the wrong way and it should be reversed.

(Counsel for plaintiffs thereupon offered in evidence a certified copy of the drawing SB 267428-1, which was received in evidence and marked "Plaintiffs' Exhibit 20-A.)

Among other changes on this drawing, I notice that the air intake pipe is an entry entering on the scrap chute of the drawing. As a matter of fact it entered below the mouth of the feed chute. By the scrap chute, I mean this little bucket conveyor. The bucket conveyor was for the purpose of taking up the coarser material that would not pass through the screen back to the feed, to the mouth of the mill.

By The Court:

Q. You mean—oh, I see.

Mr. Whitcomb: The overflow.

The Court: Oh, yes.

This inlet pipe is supposed to go right into the drum and not into that chute. Another change that I would like to note is that the hood on the top of the screen hood was flat. Instead of being conical shape, this way, it wasn't this way at all. This top of the screen hood was flat. The fan was not located as shown on this drawing. The fan was located directly on the cyclone. These changes that I have noted were on the mill when I left in 1930. With respect to the procedure for shutting down a mill, about an hour or two hours from the shut down for the week end, the operators stopped feeding lead balls into the mill, allowing the mill to kind of run down or empty most of the dust in the mill out. The object of that was to attain heat faster inside the mill on starting up again on Monday. That did help to attain heat chiefly because you are not carrying off a heavy load. The revolution of the mill was fourteen R. P. M., that of the fan twenty-eight hundred. I remember an occasion when the mill would start up without anything in it at all. That occasion was on

the installation of new mills in 1926. Another occasion was what is called a burnt mill, where the product in the mill being frozen was dumped entirely. by frozen, I mean that too much heat was obtained in the mill to mill. It could no longer operate as a mill should operate. We dumped the mill by turning the manhole covers down towards the floor, taking them off and letting the produce come out on the floor. Some of it ran out, and if large lumps were in the mill they had to be broken up to get them out. I remember doing this some time after these mills were installed that I just mentioned prior to the time I left. I do not remember the exact date. I believe the last one I remember was in the fall of 1927. After the mill is emptied, it is recharged with new lead balls and part of the lead balls that have been picked out of the stuff dropped out of the mill. Some of it is entered into the mills while stationary. When starting up the mill in the fall of 1927 after it had been dumped, all the good stuff was taken and brought up to the drum, all of the lead balls that could be picked out of the stuff that was dumped out of the mill was put back in the mill and combined with the new lead balls and entered into the mill through the chute or through the manhole cover by throwing them in by hand. That was before the rotating was started. Then the manhole cover was put on the mill again and the mill was started rotating and the remainder of the load consisting of approximately twenty thousand pounds was fed into the mill. That took a period of approximately two and a half hours or three hours, to fill the load into the mill. Very little air was turned on. To keep the dust from shooting out of the feed end of the mill, there is little air. By the end of two and a half hours to three hours a

load is in the mill. Then you wait until the mill attains the temperature of about three hundred and forty degrees of heat. No material is discharged until there is a full load. After a full load some material is discharged. That material is not used. It is a black color, and is called by the operators, scrap. It is just set aside and returned into the mills again. Depending on the mill, it takes perhaps one shift, eight hours, to get up the temperature I mentioned after there is a full load and the mill is started. Depending on the temperature reaching its height, you probably would get material that is good in six hours, seven hours, on an average. The temperature was three hundred and forty degrees. It takes about a shift, or eight hours or so, to dump a mill and start it anew.

I have had occasion to look in to one of these mills when it was rotating. That is done by opening the door in front of the discharge hood. It showed a screen with the produce revolving upon the screen. When the door was opened, that opened it to the air. The fan was still operating. It did not have a similar effect I mentioned before of dust coming out of the feed end of the mill. The door was on the front.

THE COURT: Where is he putting it? Where is it?

MR. WHITCOMB: It is way on this end of the screen.

THE COURT: Cylindrical screen?

MR. WHITCOMB: Yes. The door is on this part here (indicating).

THE COURT: All right.

That was open to the air at that point immedi-

ately on opening the door. It is a large opening as shown. I do not know the exact size of the opening of the discharge where the little conical screen is. The conical screen is smaller than this as shown on this drawing but larger in mesh. It is smaller in size as indicated there. You could see inside one of these Hardinge mills by taking the manhole cover off the mill while it was stationary. While it was running you could open the feed door on the front of the mill and go around the feed end of the mill. There was a small peep hole situated at the feed plate of the mill from which you could remove the plug and peep through the mill, having someone hold an electric light bulb in the other end. Without that procedure I never had occasion to look through. The door was made of sheet metal. They always have sheet metal. There is no way of visually looking through a drum in any of those places. At one time they had a small glass part of this same door. You could not see through that after the mill was in operation because too much dust clouded the glass.

While I was employed there they had ten mills of this kind. While I was employed there they were all exactly arranged like this. They had one other kind used for experimental purposes set aside from these mills. It differed from these in the respect that it was operated without a screen. That is, the cylindrical screen was not used. There was no discharge. They had the cyclone and bag collectors. Any material discharged from the mill all came out through one or the other cyclone or bag collector. I operated that mill. The material was disposed of by usage.

During this period of stopping on Saturday and starting on Monday, on starting upon Monday probably the first few drums coming off the mill would be good produce, and the following drums maybe five or

six in number would be too low in oxidation to use, owing to the new feed and temperature being raised in the mill. That would be a period of about six hours from starting the mill operating normally. On Sunday the mill would be entirely shut down. There would be no rotation, no air, no temperature. It would be just dead and cold. We took off maybe the first two drums of good material. That would be eight hundred pounds. That would be forty minutes. You would have then six drums of bad material in about two hours more. Then it would be up to normal after that. The bad material was refed back into the mill. There is an indication of a water cooling arrangement here. The mill itself is enclosed in a shell. You do not see the water when just looking at a mill as it is at any operating period. There is no water around the mill anywhere else. I have seen water drop into the material. It smoulders, that is, burns. I have noticed that often. It happened when some empty drums would be lying under the mill, with perhaps a little oxide at the bottom, and these hoods around the mills were not water proof and the drops of water would fall into the drums without lids, or with just a little material left in, and you had moisture and change in color. That was smouldering of the oxide in the drums.

During the years the mills were hand operated or hand fed, we used at different times wooden plugs for the purpose of shutting off the balls from going into the mill or shutting off the pellet chute. This was not all the time while we had hand feeding. Occasionally the operator used his own discretion, whether he would put the plug in the hole or not. While the mills were being fed at the rate of twenty balls every five minutes, with the semi-automatic feed, it was almost impossible to keep a plug at the feed

end of the mill all the time. We did not have any plug that I remember. During that time, the air could enter there as well as through the regular air inlet pipes. No moisture or water was put in the air as it entered either of these tubes. I do not know what the pivot tube readings were. I don't know the scale calculations. They had some pivot tube readings there on some scale.

Cross-examination.

By Mr. Morris:

I am thirty-nine years old. I have been with the USL nine weeks. I went with the USL in July or August of this year. My position with the USL is taking lead weights in the pasting department. I made my application for employment with USL through their regular channels, stating what work I had done. I gave USL this information at the time I made my application. That is, before I was employed, I gave them the information of the type of work I had been doing. When I applied for the position at the USL I described the process of my occupation then. I did not give them this information about shutting down the plant over Sundays and shutting down the mill and starting it up again and that sort of thing at the time I made my application. I am giving it now. I did not give it to them at any time before this.

Q. As I understand you, then, you were never asked for any detailed information by USL or any of its officers or employees, the information you have given on the stand today must come to them for the first time?

A. As far as I know, yes, sir.

Q. They didn't even know that the screen had been reversed at the discharge end of the mill--

A. No, sir.

Q. —until you told them today?

A. No, sir.

Q. They didn't know that you sometimes used a wooden plug when the operation was being—the mill was being fed by hand until you told them today?

A. No, sir.

Q. Are you under subpoena?

A. No, sir.

Q. How do you happen to come down?

A. Voluntarily.

Q. Voluntarily. Who asked you to come down?

A. Mr. Whitcomb.

Q. Mr. Whitcomb?

By The Court:

Q. Let us get this straight, if I may. I don't know whether you are doing yourself justice, or whether you are saying what you intend, when you speak of the present. I have a different idea. Did you give anybody this information before you gave it on the stand today?

A. No, sir.

Q. Didn't tell anybody?

A. No, sir.

Mr. Morris: Will Your Honor ask some more questions along that line, because either the witness—

The Court: No, I don't believe it, that's all there is to that.

Mr. Morris: Well, of course, I don't either, but I wondered whether—

THE COURT: I don't know whether he is doing himself justice or not. You can't tell me that you were brought down here and nobody had the slightest idea what you were going to testify to in a case as important as this, and you simply went on the stand and gave the information you did for the first time and nobody knew what you were going to say.

THE WITNESS: I had explained the type of operation I had been working at, sir.

By THE COURT:

Q. I want to give you a chance to explain that. We have been through this many, many times, we know cases are not tried that way, that's all there is to that.

By MR. MORRIS:

Q. Is there anything else you want to add in answer to either the court's question or mine, as to when you made—told any of the employees or officers of USL what you have told us, or whether you told counsel for plaintiffs?

A. During my application for the employment, I was asked what type of mills I had been employed on, and I explained it to the best of my ability, like I am doing now.

By THE COURT:

Q. I mean, now, the specific information that is being asked for, the specific fact, for instance, that that mill was regularly or frequently shut down and remained shut down over the week-end and was started up again?

A. No, sir, I did not explain anything of that.

By Mr. Morris:

Q. And you never—I am sorry.

The Court: Go ahead, that's all right.

By Mr. Morris:

Q. You have never explained that to anybody connected with USL or the plaintiffs in this case until you explained it to Mr. Whitcomb—

A. Today.

Q. —this afternoon?

A. Yes, shutting down and starting the mill again.

Q. You had never mentioned it to anybody before?

A. No, sir.

Q. Not even to Mr. Whitcomb or to any of his associates?

A. No, sir.

Q. Or the USL or any of their officers or employees?

A. I explained the mode of operation.

Q. You explained the mode of operation?

A. Yes, sir.

Q. When and to whom?

A. To the man to whom I made application for the position, sir.

Q. What did he ask you?

A. Asked me what type of mill I had operated.

Q. What did you tell him?

A. I explained it was the Hardinge type of mill.

Q. What did he say?

A. Nothing.

Q. That is where you stopped?

A. No, sir.

Q. And you didn't tell him any more?

A. As I said, I told him the type of operation, sir.

Q. But, won't you tell me, not state generally what you told him, but won't you tell me just exactly what you told him? Assume that I am the man who asked you what type of operation you were familiar with, or had been using then, or had used with the Electric Storage Battery. Now, then, give me your answer as if I were the man who asked you that at the time of your application?

A. I applied for employment, sir, and I stated in my application to the man that I had been an operator on a Hardinge mill and explained the operation as he asked me.

Q. What did he ask you and what did you say?

A. How it operated.

Q. And won't you tell me now what you told him? Don't say generally but just the words that you used for him, as far as you can remember.

A. I told him the type of mill, cyclone, bag collectors, it was loaded with lead balls which were cascaded in the mill, erupted from the discharge end of the mill, sir.

Q. Then what did he ask you?

A. I don't remember what he asked me then, sir.

Q. When did you first know that you were coming down here to testify?

A. A few days ago, sir.

Q. Who asked you to come?

A. Mr. Whitcomb.

Q. And where were you when Mr. Whitcomb asked you to?

A. USL Battery Corporation.

Q. How did he find you?

A. Through the corporation, sir.

Q. And you didn't talk to Mr. Whitcomb before or since that time until this afternoon?

A. Until this afternoon, no, sir.

Q. Let me put it this way, that if you have anything else to add as to whether you have talked to the USL people or to Mr. Whitcomb or any of his associates or any officers of the Northeastern Engineering Company, one of the plaintiffs in this suit, or Mr. Shimadzu, or any of his associates, I would be glad if you would tell it now, because I have no further specific questions to ask you about that.

A. Why, no, I don't know the officers of these organizations you speak of.

We first got black powder when the mill was started up on Monday mornings after turning the load in the mill. We did not get black powder in any mill being operated for the first time. I began working with the Electric Storage Battery in June, 1923. The mills were in operation when I went there. In those days, we were working seven days a week. So that the first time that the mill ever shut down on Sunday was approximately 1928, 1929 or 1930. From 1923 up until 1927, there was a shut down of some mills at the Electric Storage Battery plant over a week end, depending on the production that was needed. I do not know the exact time that any mill of the Electric Storage Battery plant was shut down over the week end after I became an employee of the Electric Storage Battery in the summer of 1923. For about two years after I came there we ran the mills regularly over a period of seven days. Then about 1925, we started to have Sunday shut downs on some of the mills. When we started up Monday mornings, we did not get black powder out of the mills that had been in operation the week before. There is a certain amount of good powder left in those mills when you

shut down. After the first three or four drums we did not get exactly black powder. I would only get black powder out of one new mill that was being operated for the first time. The powder we got after the first three or four drums were taken off, was low in oxidation and was gray, dark color or blackish, darker than the other powder that we had been getting. It was substantially darker. I have seen crushed slate. In answer to the Court's question, I fix the year 1925 as the first time after I went to the Electric Storage Battery that any mill was shut down on Sunday. 1925 was ten years ago. I have no difficulty in fixing 1925 rather than 1923 or 1924 or 26 or 27 as the date in which a mill was first shut down after I went to Electric Storage Battery Company.

By THE COURT:

Q. He wants to know whether you are sure that that was the year that they started to have shut-downs?

A. No, sir.

Q. You are not sure?

A. No, sir, I am not absolutely sure.

(The witness resuming testified):

These mills are operated on a three shift basis, consisting of one shift going on from seven until three in the afternoon, seven in the morning until three, one shift from three o'clock until eleven in the evening, and another shift from eleven in the evening until seven the following morning and the last shift operating on Saturday night would shut down Sunday morning until the first shift came on Monday morning. That was in vogue all the time. If the mill had been operating the previous week up until the shut down, two or three drums that came off first

on Monday morning were O. K. The color had not changed any in that mill that I can remember. There was no difference in the next four or five or six drums in 1923, 24 or 25 from those first one or two drums that I have mentioned. The color always remained about the same. The color changes after you obtain a heat temperature on the mill and the air is put in the mill. The first time I knew of a mill being shut down for a sufficient length of time to enable the mill to cool off, to get down to room temperature, was in 1923, on a Sunday. It was shut down over Sunday. The first one or two drums you get on starting it out on Monday morning were more or less like this tube of powder (indicated by counsel), substantially like that. (The tube of powder referred to by counsel was run 21, mill number 1, time 1.30 P. M. finished product of May 25, 1934, marked P-22-C). After the run of one or two drums, two or three drums had been taken off, the color of the product would change a little. It would not be as dark as the plate marked P-32 for example (indicated by counsel). It would not be exactly slate color, it would be a little lighter than that. It would be a little darker than the exhibit that was shown me. That was a lower oxidation. We tested each and every one of those drums that came off of those mills. And perhaps the oxidation would drop as low as forty-five per cent, that is forty-five per cent in specific gravity after being tested with acetic acid. I am not qualified to state whether the rest would be metallic lead. But the percentage test would show an oxidation content of less than forty-five per cent. Normal is between sixty-five per cent to sixty-eight per cent. That began in 1923. In 1926 they had installed some of the new mills, which used large balls. In 1925 we had used the two inch balls. We stopped doing that in 1926. In 1926 we used the

three inch balls. I don't remember the month when we began to do that. We did not make any other change in 1926 as to the product. Late in 1926 we experimented with the elevated semi-automatic feed conveyers. They introduced the semi-automatic feed in 1926. The freezing of the mills would happen occasionally at almost any time, owing to the heat temperature of the mill going up above normal capacity. Normal capacity was three hundred and forty degrees. I was there until 1930. I began in 1923. I had several experiences of burning the produce in the mills. I cannot fix the times for that. I cannot say the exact time for any of those. 1927 I believe was the last time I had a mill freeze. While I was employed there the screen was always the reverse of what is shown in this picture. The point of the cone was pointed outwardly instead of inwardly. The discharge from the cyclone was to a separate drum some part of the time I was there. I don't know the exact time when that was switched so as to provide a conveyer from the bottom of the cyclone chamber back to the discharge drum from the main machine. I don't know the exact time when they stopped using the wooden plug either. I do know that somebody used a separate drum for the bag collector chamber. I think the year was 1928. 1928 was the year when they stopped using the separate drums below the bag collector. They stopped using it beneath the cyclone the same year. I fix that from experience. I fix that the same way I fix 1927 for the last freezing up of the mill. I don't know the exact day and month of 1927 when that occurred. Those dates are hard to remember. It was in the latter part of the year 1927. I fix it as the latter part of the year because that is how I remember it. It wasn't 1928 instead of 1927 as I remember. I am quite clear that that is not the fact.

It could not have been 1926, but other cases could have happened of the same thing in 1926. The suggestion that it was in May, 1927 would not help refresh my recollection. These occurrences were not exactly frequent, but such things happen so often you cannot recall the dates exactly. I believe it was later in 1927 than May.

Q. And you have told that to whom prior to telling it on the stand today?

A. No one, sir.

MR. MORRIS: That is all.

THE COURT: Now, I do not want to do this witness any injustice, but he has given me the impression, somehow, that he has been just brought down here as we say, cold, nobody knew what he was going to testify to. He hasn't talked over the subject of his testimony with anybody. If that is the impression he wants to leave with me, it is all right.

MR. WHITCOMB: Could I ask some questions which might—

THE COURT: Yes, I would like to know what the situation is. Not that it makes a great deal of difference, but it just means to me that it is not entirely credible.

MR. WHITCOMB: No.

THE COURT: These cases are not prepared that way.

Re-direct-examination.

By MR. WHITCOMB:

Q. Last night at the hotel I met you and Mr. Nagle, is that right?

A. Yes, sir.

Q. Who were in the room?

A. At first, you were, sir.

Q. And Mr. Nagle?

A. Yes, sir.

Q. And yourself?

A. Yes, sir.

Q. And later who was there?

A. Mr. Shaffer, sir.

Q. And before Mr. Shaffer came, who did most of the talking, would you say?

A. Mr. Nagle.

Q. Mr. Nagle and I—

A. Yes, sir.

Q. —did I do any talking?

A. A little.

Q. Did he talk about some of these things you have been talking about now?

A. Yes, sir.

Q. Quite fully?

A. As fully as I have tried to explain them, sir.

Q. Did you say much to me?

A. No, sir.

Q. Then what happened?

A. Mr. Nagle went down to Philadelphia.

Q. But Mr. Shaffer came down in the meantime?

A. Yes, sir, Mr. Shaffer came down also.

Q. With whom did he talk?

A. Mr. Nagle.

Q. Did he talk with Mr. Nagle as much as he had with you or not?

A. More with him than me.

Q. These details you are talking about, Mr. Nagle talked about quite fully, is that right?

A. Freely, yes, sir.

Q. Is that what you had in mind when you testified?

A. Yes, sir.

Q. Before that, when you made your application with USL, you said before that you talked about answering questions broadly about this mill. Is that your testimony?

A. Yes, sir.

Q. But these details you are talking about came out when you were talking with Mr. Nagle last night, is that correct?

A. Yes, sir.

Q. Before that did you mention anything about the cone at the outlet of the mill?

A. I might have mentioned in my application what the mill consisted of.

Q. Did you say which direction that cone was pointed?

A. I said the cone was pointed outward at the mouth of the mill.

Q. You said that last night, I know, but did you say that before that?

A. No, sir, no one asked me.

By The Court:

Q. Did you discuss these Sunday shutdowns and the character of the product you got after the shutdown? Did you discuss that?

A. Yes, we were talking about that fact?

Q. I certainly thought so. It was not the impression you left with me on your direct-examination.

By Mr. Whitcomb:

Q. We want you to tell it fully and explain it to the judge. We are just as much concerned in seeing—oh, I think I might as well say what I am driving at—

THE COURT: I shouldn't be at all surprised. Witnesses get on the stand, they seem to think it is a criminal offense to give information to their own counsel or counsel for the party that calls them before the case; they always put themselves in a bad light that way. Everybody knows that competent lawyers in an important case are not putting witnesses on the stand unless they do know pretty well what he is going to say. It just is not done. The witness tells me he has never told anybody what he is going to testify to. It is certainly not usual or a likely thing. There is no harm in talking the case over with counsel. No harm at all in giving counsel the information on what you are going to testify to. Well—

MR. WHITCOMB: No.

THE COURT: —all right.

MR. WHITCOMB: I would rather have his talk without my talking to you—

THE COURT: I understand.

MR. WHITCOMB: —because I would be leading too much.

MR. MORRIS: I would rather you would not lead this witness.

THE COURT: I understand, certainly.

By MR. WHITCOMB:

Q. I want you to tell the court completely if that is what you had in mind when you say you didn't tell these things to any detail?

A. Yes, sir, that is right, sir.

Q. You were afraid of saying something erroneous?

A. Yes, sir.

Q. Namely, you had not told me about this coning until last night?

A. Yes, sir.

Q. Isn't that the fact—

A. Yes, sir.

Q. —and absolute truth?

A. Yes, sir.

Q. But were broad things you had talked—

A. Yes, sir.

THE COURT: It is not an important matter.

THE WITNESS: On the general subject, yes, sir.

MR. MORRIS: There is one phase that bears some little importance.

Re-cross-examination.

By MR. MORRIS:

Q. Mr. Cooper, I think you understood the court—

A. Yes, sir.

Q. —that if you had told the details of the Philadelphia operation, the Electric Storage Battery operation to anybody before you came here, it was all right for you to say so?

A. Yes, sir.

Q. You don't have to deny it. With that aid from the court, do you want to correct your testimony at all?

A. Well, I would like to correct that. I have explained to Mr. Whitcomb last night, the operation with Mr. Nagle, the operation in general of the process that the mills working—.

Mr. Nagle was an operator that operated with me at the Electric Storage Battery. He is not employed

with USL. I do not know when Mr. Nagle left the Electric Storage Battery. It was in or around '33 or '34. I am not sure. Generally speaking, in my application, I stated the same thing as in the conversation last night. When one applies for a position and is asked to state the nature of one's work, you have to state it fully to your ability. That I did. I did not explain in the application about the mills shutting down. The first time after making the application that I explained that orally to any representative or officer or employee of USL was last night. I explained it to Mr. Whitcomb. Last night was the first time as I remember. I have explained that process to Mr. Reid of the USL. He is an engineer. I explained to Mr. Reid the same as I have explained it here this afternoon. That was before I was actually employed by the USL. I applied about two and a half years ago for a position when I made that statement to the USL Corporation, but at that time they didn't have any position for me and they were kind enough to find me a position with the Battery and Starter Company of Buffalo. That is where I was employed up until there was a position available for me at the USL. I explained that in my first application two years and a half ago. It was after I made that explanation about two and a half years ago that I found the position with the Battery and Starter Company. I did not give them any other information than that which I have talked about this afternoon. None at all. I didn't tell Mr. Reid about the oxidation content of the darker powder which filled the third, fourth, fifth and sixth drums and so on after starting of the mill afresh on Monday morning. I don't think he asked me that. I first discussed that with Mr. Whitcomb and Mr. Schaffer last night.

(Witness excused.)

MR. SCHAFFER: Plaintiff offers in evidence the file wrapper of the abandoned application for Shimadzu, serial number 431,473, Exhibit number 39; and the answers to interrogatories of the defendant and the amended answer to plaintiffs' interrogatory number 6, Exhibits 40 and 40-A.

(File wrapper of abandoned application of Genzo Shimadzu serial number 431,473 was marked Plaintiffs' Exhibit 39.

Answers to interrogatories by defendant were marked Plaintiffs' Exhibit 40.

Amended answer to plaintiffs' interrogatory number 6 was marked Plaintiffs' Exhibit 40-A.)

MR. SCHAFFER: Plaintiff offers in evidence the interference record in Interference in the United States Patent Office between Hall and Shimadzu, number 54,798 and 56,224, copies of which are now in the files of the Clerk.

MR. MORRIS: That is the whole record, isn't it?

MR. SCHAFFER: Yes.

MR. MORRIS: That is the consolidated record.

MR. SCHAFFER: The entire record has been filed by the defendant in connection with the inspection.

Your Honor, in connection with the bills of particulars of both parties it is understood that those are now in evidence, are part of the record, having been filed.

MR. MORRIS: Not in evidence, but a part of the pleadings.

MR. SCHAFFER: Part of the pleadings, is that correct?

THE COURT: All right.

MR. SCHAFFER: The exhibit number for the Interference is 41.

(Interference records between Hall and Shimadzu number 54,798 and 56,224 were marked Plaintiffs' Exhibit number 41.)

(Discussion off the record.)

MR. MORRIS: You needn't put the paper in, but it will be subject—

MR. WHITCOMB: Sure.

MR. MORRIS: —to our inspection any time we want. It is the long license agreement between Shimadzu and the Northeastern, and we do not require them to prove it formally, and if they want to read parts of it in the record, why, we have no objection, provided it remains subject to our correction.

THE COURT: All right.

MR. WHITCOMB: I would rather have the witness just state what it is.

MR. MORRIS: We admit—

MR. BETTS: It is stipulated that there is an exclusive license from Shimadzu to the Northeastern Engineering Corporation.

MR. WHITCOMB: Proffer of the paper being made.

MR. BETTS: Under the patents in suit.

MR. MORRIS: I think you would have to show by reading in the record that part which shows—

THE COURT: Oh, can't we short-cut that? I

will say without looking at it that I will interpret that as an exclusive license, unless the defendant shows me that it is not.

MR. MORRIS: You see, we don't know.

THE COURT: But you will have opportunity to study it.

MR. MORRIS: By the inspection.

THE COURT: Yes.

MR. MORRIS: Yes.

THE COURT: At any time during the trial.

MR. MORRIS: Yes, that is perfectly all right.

MR. BETTS: It is stipulated that when the witnesses have spoken of the Exide mills and products from them that they mean the mills operated by the defendant in their plant at Philadelphia.

(Discussion off the record.)

MR. SCHAFFER: If Your Honor please we are at the point now where we would like to inspect some of these papers we asked for. Beyond that we have about come to the conclusion of our prima facie case.

(Discussion off the record.)

PLAINTIFFS REST.

Counsel for plaintiffs offered in evidence the translations of Exhibits 7 and 8, subject to correction.

which were received in evidence and marked "Plaintiffs' Exhibit 7-A" and "Plaintiffs" Exhibit 8-A" respectively.

DEFENDANT'S EVIDENCE.

Counsel for defendant offered in evidence Defendant's Exhibit A for identification, being the sheet upon which Dr. Clark while on the witness stand wrote certain chemical formulae which was received in evidence and marked "Defendant's Exhibit 1".

Counsel for defendant offered in evidence as Defendant's Exhibit 2 the work sheet produced by Dr. Clark at the request of the defendant and marked Defendant's Exhibit B for identification, being the measurements for the film represented as number 6 on Plaintiffs' Exhibit number 21, which was received in evidence and marked "Defendant's Exhibit 2".

EDWARD W. SMITH was called as a witness on behalf of defendant and first having been duly sworn testified as follows:

Direct-examination.

MR. MORRIS: I propose to prove by this witness briefly this, that Mr. Smith has been associated with the Electric Storage Battery Company for about thirty-five or thirty-seven years, that in 1906 he went to Germany to see the process that was being used in Germany in a revolving drum mill, that thereafter the defendant imported some of this material, and it was made into plates; in 1912 and 1913 Mr. Smith went

back to Germany and saw their improved process of a revolving mill, getting powder therefrom; that in 1916 or thereabouts the Electric Storage Battery Company installed a mill and made the product, the oxide, by revolving chunks of lead or balls of lead in a mill, that they put that into commercial operation, they made plates out of it and sold the plates, and that the mill was then shipped to the Willard Storage Battery Company, out in Cleveland, and the Willard Storage Battery Company used the same mill, with the same results; they made oxides from a very low degree of oxidation up to a high degree of oxidation when I am speaking of high degrees of oxidation I am not particularly concerned as to whether Your Honor interprets that at the moment as meaning any particular form, to us it is PbO, always, I mean that it was calculated as PbO and as PbO it may have been twenty, thirty, forty, fifty, sixty, seventy, eighty or ninety per cent; that the Willard Storage Battery put the product of the mill—they used it in 1920; we began in 1916—they put that right in with their other material and made plates out of it in the usual commercial way.

I think that—

THE COURT: All right.

MR. MORRIS: —may give you some idea of what we intend to prove by this witness and also by several other witnesses.

By MR. MORRIS:

I reside in Germantown, Pennsylvania. My occupation is work with the Electric Storage Battery Company, the defendant in this suit, as engineer. I have been connected with the Electric Storage Battery Company since the latter part of 1897 which was about thirty-seven or eight years ago; I guess. I first went in as what was called a cadet, a sort of training course,

where they trained young men in the work. I stayed in that capacity for some months or possibly a few years. From that I was made factory engineer and continued in that capacity until two or three years ago. My present title is Manager of Development and Design Division. Prior to going with the Electric Storage Battery Company I had a college course at the University of Pennsylvania with the degree of Bachelor of Science in Chemical Engineering. The business of the defendant, The Electric Storage Battery Company, since my connection with it, has been the manufacture of electric storage batteries for all kinds of purposes.

I visited Germany in 1907 in the summer. While there I visited the works of the Accumulatoren-Fabrik Aktiengesellschaft which was the large storage battery company in Germany operating all over Europe, which I will hereafter refer to as A. F. A. I went into the mill of A. F. A. while in Germany. It was engaged in the manufacture of all kinds of storage battery plates for storage batteries. They were making a large variety of storage battery plates, but the pasted plates to which I presume you refer were made at that time mostly with active material of the ordinary oxides. But they were making some of their plates at that time with oxide made from a new mill which they had recently put up, a cylindrical mill which contained lead balls which were rumbled up within. The product of that mill in Germany was called "Bleistaub", which means lead dust in English. At that time I made a brief note recording the fact that I had seen the mill and telling in a very preliminary sort of way what it was about. This paper which you hand me is the note, the page taken from my original note book showing the note that I made while in Germany with regard to this mill on August 30, 1907.

Mr. Morris: I offer it in evidence as Defendant's

Exhibit number 3. It is number one in Your Honor's book.

MR. WHITCOMB: Just for the purpose of the record, we want to object to any testimony of a public use in a foreign country as far as that part of it is concerned.

THE COURT: Well, it will be taken subject to the objection under the equity rule.

MR. MORRIS: In order that Your Honor may understand our position as we go along, I am not disputing the general law with respect, or the established law with respect to public use in a foreign country, of course I am not, but when Mr. Smith knew of that he brought that knowledge back to America, and that then became American knowledge, and he put that knowledge into use in America, so that we only show where we got that knowledge and when we got it, and what that knowledge was.

THE COURT: Yes.

The page dated August 30-07 from the note book of the witness was thereupon received in evidence and marked "Defendant's Exhibit 3".

(The witness resuming testified):

After returning to Philadelphia, I arranged to have a sample of the lead dust sent to Philadelphia and from this sample had a number of Electric Storage Battery Company's Exide grids pasted for test purposes. I have the date when some of the plates were made from that lead dust. January 15, 1908, the laboratory test number 4235 was started, calling for setting up and testing certain cells with plates made by me from the German lead dust and according to their process. We subjected the plates so made to a life test.

I will tell you generally what the process that I saw in Germany consisted of.

They had an iron mill, about sixty inches in diameter, thirty-eight inches long, mounted on a horizontal axis and caused to rotate at a low rate of speed, thirteen or fourteen revolutions a minute. The drum of this mill was perforated with a considerable number of small holes, about an eighth of an inch in diameter. Lead balls, small lead balls five-eighths of an inch in diameter about, were introduced into the mill, and were there subjected to the action of the air within the mill and to the grinding action of that mill, so that out of these holes there came fine powder of so-called Bleistaub, or lead dust.

If I may go back just a step, the mill itself was surrounded by a wire gauze screen, attached to the mill and rotating with it. The lead dust came first into this space between the two. That separation was approximately six or seven inches. Then the lead dust came through, afterwards finally came through the screen, this outer screen, fell down into a casing with a conical bottom, conical or pyramidal, and there was concentrated into a pipe which led down at an angle of about forty-five degrees to the collecting kegs, steel kegs or barrels, in which the stuff was finally collected.

We imported a second lot of lead dust from Germany after this first one. I have a copy of the purchase order sent to the A. F. A. for the second lot. This paper that you hand me is a purchase order dated December 21, 1908 calling for five hundred pounds of lead dust for positive plates, sent to the A. F. A. in Berlin.

(Counsel for defendant thereupon offered in evidence as Defendant's Exhibit 4 the purchase order dated December 21, 1908 to A. F. A. for five

hundred pounds of lead dust for positive plates, which was received in evidence and marked "Defendant's Exhibit 4".)

We made other plates from this second importation of lead dust. We put those plates on test. This Exhibit, Defendant's Exhibit 5, which you hand me is a note from me to Hr. Howard who was the director of the laboratories, describing some plates which I had made from this second lot of lead dust and given to him for test. It is dated seventh month, twentieth, 1909, and the note was evidently handed in some time after the test had been started. The note says: "Mr. Howard, regarding plates Z 155, etc. I find Z 155 standard M V positive grids, pasted with German lead dust, pressed, and all directions followed as closely as possible. 157-58 and 59 also M V positive grids, pasted with a newly imported lot of lead dust, the pressure being varied, in all other respects the German directions closely followed—and also sundry notes of the weights of active material in those plates."

(Counsel for defendant thereupon offered in evidence as Defendant's Exhibit 5 the note dated 7-20-09 from Smith to Mr. Howrad which was received in evidence and marked "Defendant's Exhibit 5").

This paper which you hand me is a copy of a letter written by me to Director Roderbourg of the A. F. A., dated April 17, 1909, treating the various matters, and near the last occurs this paragraph: "The keg of lead dust arrived in good condition and we at once made up some samples with it", that is, from it. "It is quite likely that in our former tests we applied too much pressure to the plates, and thus cut down the capacity", and so on. There is one more thing I might

add there. In that paragraph also occurs this: "To make this test as complete as possible we are sending you an order for 50 of your latest standard positive grids and 25 finished positive plates of the same type, all of the size nearest to our MV that is 8⅞ x 5¾"". I think that the only part of this letter that pertains to the issues here is all on the last page, the paragraph most of which I read.

(Counsel for defendant thereupon offered in evidence as Defendant's Exhibit 6 the first and last pages of this letter dated April 17, 1909, from the Factory Engineer to Director Roderbourg of the A. F. A. which were received in evidence and marked "Defendant's Exhibit 6").

Mr. Howard to whom I have referred once or twice, is and has been for many years the chief chemist of the Electric Storage Battery Company, a part of whose duties is the operation of the commercial laboratory which takes care of all of the life tests and any other tests of batteries. This paper which you hand me is a voucher dated February 20, 1909, showing the price that was paid for this second importation of lead dust. It is marked "Payable to Brown Bros. & Co."" (Counsel for defendant thereupon offered in evidence as Defendant's Exhibit 7 the voucher dated February 20, 1909, to A. F. A. which is received in evidence and marked "Defendant's Exhibit 7"). I would like to add that there is a slight apparent contradiction in that voucher, because it speaks in a note at the side, pencil notation, as if it were plates that were being imported instead of lead dust. The explanation of that, with the marking of plates, means that the experiment was charged to plates. It was charged to the manufacture and development of plates.

Some of the records in our plant we keep for a

long time, some of them are thrown away. When we want them they are often not to be found. But in this particular case, we were able to find a great many of the old records.

Defendant's Exhibit 8 which you hand me is a cancelled check made to the order of Brown Bros. and Co. dated February 20, 1909, for the payment of this second importation of German lead dust.

(The check dated 2/20/1909, from the Electric Storage Battery Company to the order of Brown Bros. and Co. for $25.80 was thereupon offered and received in evidence and marked "Defendant's Exhibit 8.)

Brown Bros. are bankers.

Included in test 4235 were a number of plates made complete in Germany, according to their standard method, in addition to the plates which were pasted in this country with the German lead dust. The test folder comprises in all 24 individual tests and covers the interval of time between January 15, 1908 and October 27, 1909. The test folder complete is preserved in the company's records.

I made another visit to Germany in the winter of 1912 and 1913, when I again visited Hagen. That trip was undertaken largely for the purpose of getting the latest information on the manufacture and use of the lead dust. I did get such information as fully as I was able. I investigated very carefully the operation of their lead dust plant which by this time had been increased, as well as the methods of manufacturing lead dust plates, which by this time had become a standard commercial product. While in Germany I made a number of notes showing what I saw and learned there in the A. F. A. plant.

MR. MORRIS: I offer those notes in evidence as Defendant's Exhibit number 9.

THE WITNESS: May I make a slight correction? What you are offering in evidence is not all of my notes, it is typical pages, a number of them.

(Pages from the note book of the witness, dated in December 1912 and January 1913 were thereupon received in evidence and marked "Defendant's Exhibit 9".)

The papers that you hand me as Defendant's Exhibit 9 are typical pages. I will point out to you in those pages what I found in Germany at that time and the knowledge that I there gained and brought back to America with me.

The first of these pages is dated December 12th. It has a heading at the top, "Dr. K.", which signifies that the information was given to me by Dr. Kieseretzki, who was the man who had developed and perfected this process of making lead dust, and its application to storage battery plates. I had many conversations with Dr. Kieseretzki in which he told me as much as he was able to and as I was able to understand, he talking broken, very broken German, Russian-German, and I talking exceedingly meagre German-English, but between the two he was able to convey a number of ideas to my mind as to what they were doing. I recorded those ideas on those pages, this particular one on December 12, 1912. The next is dated December 20, 1912; another one not dated but taken from the same note book is also from Dr. Kieseretzki. I have some that were given me by Dr. Melchiker who was the German chemist at Hagen at the time in the A. F. A. I have others that are sketches showing the mill, taken from the actual installation. Various parts of

these notes were given to me by the foreman who operated the mills, and some by Dr. Roderbourg, some by some of the other people who knew about the use of these plates and their performance. I had access to the whole plant and to the methods.

Mr. Whitcomb: There is another, further objection on the point of patent law, in our opinion, that we want to register at this time and have it apply, namely, that the knowledge incorporated in this country, as we interpret the law, must be knowledge of the thing in this country, prior knowledge and use, knowledge or use, it does not mean just written knowledge unless it is published in this country, so we want that further objection.

The Court: I will note the objection. I am wondering whether it is necessary to go into this as elaborately as we are doing, because I don't know that it is even corroborative of what was done in this country or what was published in this country. Suppose he did get all this information, suppose it is conceded that he got all this information in Germany, it does not prove that he made use of this particular information when he came to this country.

Mr. Morris: But the statute goes a little further than that, as I understand it, it is knowledge which prevents a patent, where there is knowledge of it in this country, 4886 of the Revised Statutes deals with knowledge as well as use, but we are going to follow this now immediately by showing that we made plates and sold them in 1916 and 1917.

Mr. Whitcomb: That might apply to the plates but not to the process or the machine.

The Court: Well, that is another question I have in mind, whether the testimony here indicates anything

more than the fact that powder-paste was used instead of solid plates.

Mr. Morris: It is one of the bits of evidence which goes to show that here was a process that was being employed, that the knowledge of it came to us from Germany initially in 1906 and 1907, the knowledge of it has been here since that time, the plates were made of it, they were sold and put in use, and prior to the earliest date of any alleged conception on the part of the plaintiff here in suit.

(The witness resuming testified):

I have Exhibit 9 right here. Among other things showing knowledge which I acquired of the process and mill, I find in the Exhibit:

Well, lead powders intended for cabs, getting very hard, constant service; mill is controlled entirely by the lead powder produced. When once a mill gets running right the product is weighed and the same amount of balls put in as powder comes out, plus a small amount for oxidation.

One motor drives two mills at the same speed.

The powder is slightly greenish. It must feel smooth between the fingers, and very fine.

Specific gravity is mentioned here, a note of Dr. Kieseritzki, taken from Dr. Kieseritzki, the lead dust very likely is a suboxide Pb_2O. It becomes thus slightly oxidized in descending from the mill to the keg, and this becomes, therefore, one of the important steps in the manufacture. The mill itself is closed up tight except for a small opening through which the balls enter; the main entrance for air is by means of the two small openings in the cover of the keg, A in figure 1. These openings must not be closed. If they be closed, and no air allowed to enter, the powder enters the kegs in rather emtallic condition, very black

in color and very ready to oxidize. It then takes up oxygen in the keg, which apparently is not air tight, becomes red hot, and so remains until it has become thoroughly converted to litharge.

In other words, this powder was exceedingly reactive, and there is a slight discrepancy in that particular part of my note, because it leaves out the holes in the mill which allow the air to enter within the mill. The perforations are about an eighth of an inch, some fourteen hundred of them in the mill. The powder where the volume of air was reduced was more reactive than where these holes were kept wide open. If less air entered the oxidation was lower. It was less reactive when the oxidation was higher.

After returning to Philadelphia from this trip to Germany in 1912 and 1913 I wrote out a general report of the trip that was handed to the President of the company. This report opens with the subject of lead dust, and the first ten pages are devoted to it. The report is divided into a number of headings, "Status of Lead Dust in Germany", "Applicability of Lead Dust for the E. S. B. Co.", "Probably Cost of Manufacture of Lead Dust Plates", "Manufacture of the Plates". That report is still in existence but I don't happen to have it among my notes.

Mr. Whitcomb: If Your Honor please, I think the record ought to show that this witness is reading his answer from a book, apparently prepared. I don't know that it means a lot, but I think it ought to be in the record.

The Court: All right.

(The witness resuming testified):

I am using notes. These notes were prepared by me and under my direction. I have checked the ref-

erences. It is merely for convenience of memory in testifying. Largely to save time, so that I will have the thing as condensed as possible, and delay the Court as little as possible.

The lead dust as used by the A. F. A. in January 1913, was a fine powder, consisting of lead in a somewhat oxidized condition, or more accurately, perhaps, some of which was oxidized and some was not. It was of a dark color, slightly greenish tint. It felt quite fine between the fingers, and it was very decidedly pyrophoric, that is it would burn quite readily in the air, when touched off with a match it would smoulder and the whole thing gradually burn, get hot and turn to litharge. They were able to change in the manufacture various of these qualities, such as color and reactivity, over quite a wide range, by the amount of oxidation and the fineness. Standard practice as I discover it at that time was to produce material of an oxidation, as they put it, material of a lead content of ninety-four to ninety-five per cent, and that translated into the terms that we have since used has content of PbO from fifty-six to about seventy per cent. The color of their commercial product was dark, dark color, slightly greenish in tint, possibly slightly gravish, a color very difficult to define accurately. They placed a good deal of reliance on tests of apparent specific gravity made by taking a small porcelain crucible and pouring the stuff into it loosely and then scraping off the top, and the specific gravity was slightly above 2, 2 to 2.3. That is given in some of these notes. Apparent specific gravity is taken by taking a certain volume of powder and comparing its weight with a weight of like volume of water. Stated a little more simply, it is the weight per cubic centimeter, weight in grams per c. c. You are right that there is a reference in one of my notes, Defendant's Exhibit 9", to the composition of

the lead dust as ninety-five or six lead, and a further remark that the lead is thus about half oxidized. I don't see that reference but I remember it is in here. The lead dust as made in Germany of which I obtained knowledge in 1912 and 1913 was very reactive to oxygen. It would very readily take fire in the air. It would become red hot and give off a little smoke and the lead content which it contained would be oxidized to litharge, so that by the time the combustion was through the whole thing was bright yellow litharge. That took place even unintentionally, spontaneously in the kegs in which the material was packed. The kegs were not literally air-tight. Those kegs were steel drums. The A. F. A. knew that the material oxidized very readily, that it began oxidizing immediately after it was made. They therefore made a rule that it must be used within three days from the time it was manufactured, in order not to use any of the very high oxidation, that is a higher oxidation than approximately the figures that they have given.

(Counsel for defendant thereupon offered in evidence, as Defendant's Exhibit 10, a blue print marked "Abbé Engineering Co. New York, dated July 24, 1915, Special Cylinder for Electric Storage Battery Company", which was received in evidence and marked "Defendant's Exhibit 10).

Exhibit 10 which you hand me is a drawing by the Abbé Engineering Company, dated July 24, 1915, and shows a mill which we purchased in this country, from this concern, made according to information which we had given them, and in all respects duplicating exactly the German mills of which I have been talking. It will be noticed that this mill has a number of small holes of slightly under an eighth inch diameter at the smaller end, at the inside. I find that at the bottom of the

sheet. And I would like to point out here this slight discrepancy that I mentioned in my notes because this shows the holes by which the air could enter the mill in addition to possible leaks at the trunnion. Trunnion means the large bearings by which the mill is supported, one at each end, which you, as a layman, might refer to as an axle. One of these trunnions or axles is hollow, for the introduction of the lead balls within the mill. The other is closed.

Mr. Whitcomb: We might make an objection that this is a blue print, we don't know what time this blue print was made, or if the original tracing is available. Sometimes they make blue prints just—

Mr. Morris: Just what?

Mr. Whitcomb: —a month ago; secondary evidence, a blue print is, prima facie.

(The witness resuming testified):

I can give you further information by referring to my notes I think. (Counsel for defendant here offered in evidence drawing marked "Supports and House, Lead Dust Mill, The Electric Storage Battery Co.", dated 9/25/1915, which was received in evidence and marked "Defendant's Exhibit 11).

Referring to my Exhibit 7, which is "Defendant's Exhibit 11, I can show you the tracing in this case of the building which was erected at our 19th Street plant, showing the outline of this mill, this Abbe mill, which was afterwards installed there. The drawing bears date of ninth month, twenty-fifth, 1915, gives the weight of the machinery, the weight of the charge within the mill. This building, not only the blue print, but the building is still in existence and can be seen at the plant of the Electric Storage Battery Company, with the marks on the beams, and in general corresponding to this drawing, although the mill itself is not there.

That is the original drawing. If I remember right, we had a requisition for that building, didn't we? We gave to the Abbe Engineering Company a drawing of what we wanted, they made this drawing from ours, elaborating it still further, giving the details which they proposed to furnish. The original tracing of this drawing I have never had in my hands, but this is the drawing from which we ordered the mill. This blue print is the record by which we ordered the mill from the Abbe Engineering Company. This blue print was our original record. I can tell that by the number here pasted on the drawing, O. F., which means outside drawing, of a certain size. That was kept in our list of drawings as an outside drawing, not made by us. The mill made according to this drawing of Abbe's was set up, finished and ready to run during the early part of 1916. I had that Exhibit 10 well before that time, because the mill had been purchased and set up in accordance with that print. It was finished and ready to run in the early part of 1916.

Mr. Whitcomb: Is your Honor going to make a ruling on this blue print, or not?

The Court: Oh, no.

Mr. Whitcomb: Just take it subject to any objection?

The Court: Surely.

(Counsel for Defendant here offered in evidence as Defendant's Exhibit 12, blue print entitled "Projekt fur die kugelmuhlenanlage in Lille" which was received in evidence and marked "Defendant's Exhibit 12.")

This exhibit is a blue print handed me in Germany in the winter of 1912 and '13, showing a projected in-

stallation of two mills at Lille, France, by the A. F. A. and given to me as a basis for the setting up of our mill here, and this general installation was followed in the setting up of this Abbe mill which I have just told you about. That shows the same general arrangement. That is the only copy I have. It shows two rotatable mills. The mills are located on a platform about fifteen feet high, mounted within a casing, the pipe running down from that casing to the collecting drum at the bottom. Where the pipe runs down into the drum is a kind of a conical heading to the drum, where the pipe runs in. In that conical heading of the drum there are a number of holes, shown plainly in the drawing, and in describing the operation of the mill to me they were always very careful to say that some of those holes must be left open in order to allow a stream of air to pass up the pipe and into the casing surrounding the rotating drum, in order to get some—to produce the necessary oxidation of the balls, the air, of course, coming into the interior of the mill itself through the small eighth-inch holes. And these holes in this pipe were one of the means which they used for controlling the process, they had to always keep some of those holes open, sometimes they would shut them down partially for a short time, but they had to let the air go in there, and that was described to me as one of the essential parts of the process. This shows a mill that was rotated on its trunnions. The feed of the lead part, chunks or pieces, was made through one of the trunnions, which one was hollow. The mill was then rotated in the neighborhood of twelve, thirteen or fourteen R. P. M. It is stated in my notes more accurately. It was about thirty-eight inches long, I think. Its diameter was sixty inches. The perforations in the outside of the drum were slightly under an eighth of an inch, and as I remember about fourteen hundred of

them in the mill in the outside wall of the mill there were about 1440 or 50. The mill was surrounded by a screen. And the screen in its turn was surrounded by a fixed casing. There was a sort of leg or discharge chute at the bottom of the fixed casing, and the holes or openings to which I have just referred were at the bottom of that chute. This chute was not an open chute but stove pipe shape, roughly speaking. At or near the bottom of the chute there were two or more openings used to control a stream of air which flowed up through this pipe. It would be right to say that it controlled the volume of air that went into the casing surrounding the mill, and, therefore, also the amount of air which entered into the mill. A question naturally arises in that connection, which I think I might as well explain, that there is no exit for that air shown at the top of the casing, the air got out of the casing by various leaks and cracks and crevices as best it could, but there was no question about there being a distinct flow of air up this pipe and around the casing. The product was oxidized. It came out through the holes in the drum and then into the surrounding screen which revolved with the drum and passed through the mesh of the screen into the fixed casing or housing, the bottom of which was hopper shaped. At the bottom of the hopper or funnel was this stove pipe appearing outlet.

I find in one of my notes here that I did not read, that in May 19, 1915 a requisition was made out calling for one special ball mill, as per Abbe Engineering Company's specification dated March 29th, 1915, drawings to be submitted and approved before commencing work. That is the drawing which has been given as "Defendant's Exhibit 10".

Referring to the German mill, the charge in the mill was in the neighborhod of a couple of thousand

pounds. It varied a little up and down. There was no very accurate means of determining what it was. The heat was supplied to the mill by the reactions and by the friction in the mill, friction and chemical action, the friction of the balls rolling over each other as well as the friction of the balls and the drum together.

THE COURT: Judge Morris, is this the A. F. A. Mill?

MR. MORRIS: Yes, sir.

After this friction began, the surface of the balls was worn away, there was oxidation, no doubt, worn away and dropped through the holes. In the light of present day knowledge, there is no question that the oxidation of the surface occurred first before the wearing away. The oxidation of the balls occurred before there was wearing away or breaking up of the lead. At the time I didn't even comment about that.

There was no direct measurement of the temperature inside the mill. There was a thermometer in the casing, outside, but there was no measurement of the temperature inside.

I recall that the thermometer was outside of the revolving screen between the revolving screen and the fixed casing surrounding the drum. I think I have the recorded temperature. I didn't find the temperature at which the German mill was operated but we can easily get it.

Control of the product was a rather intricate matter in this old German mill. It depended upon the amount of balls in the mill, it depended on the temperature and to some extent on the speed of rotation and the amount of air. It was possible to control the temperature only indirectly. It required a very nice balance of these two factors in order to get the mill working properly and to keep it working properly. They

did keep it working properly. There was a great deal of personal skill required and the man had to get accustomed to it in order to be able to hold the product that he wanted, but they had that skill. I learned while there what was essential to control the product. I aranged to send over to Hagen some M V grids of different thicknesses.

(A print headed "Blechmantel" No. 14-166, was here offered and received in evidence and marked "Defendant's Exhibit 13".)

Referring to "Defendant's Exhibit 13", that discloses the shell on the drum of the German mill; the cylindrical shell. The rounded circle discloses that. That is marked fifteen hundred and twenty millimeters, which corresponds very closely to sixty inches diameter. It shows a total of fourteen hundred and eighty-six holes. That fourteen hundred and eighty-six is on the right hand side near the upper corner, fourteen hundred and eighty-two locher. Those red cross signs near the right hand middle of the page represent the center of it, of which there are fourteen hundred and eighty-two in the entire wall of the drum. This blue print also shows that the drum was made of steel casing, the thickness and strength of the shell ten to thirteen milimeters and the length eight hundred and ninety milimeters, or about thirty-seven inches, or something like that. It may be of interest to say that it shows the total area of the holes to the interior of the mill, which if figured out, shows the sum total of the small holes, also a sketch of one hole about four and a half inches in diameter. Blechmantel means sheet covering. The trommel is the mill. Kugel is bullet. Trommel is a drum, I think, that circular part. Drum of the large ball in the old turbine house.

MR. MORRIS: Ball and bullet are close together.

THE COURT: Yes.

I got this blue print at Hagen in the winter of 1912, 1913, although the date of the drawing is much older than that. 1907 is the date of the drawing, but it is not when I got it. I brought it back with me when I returned from my visit in 1912, 1913.

Returning to the grids which I had sent to Germany, owing to the fact that the lead dust in transportation was necessarily kept for a matter of weeks or perhaps a month or more, I realized that in that process it was subject to further oxidation, so that by the time we got them to this country, and pasted the grids, it no longer would be strictly characteristic of the original material. I, therefore, had some of our grids sent to Hagen, pasted there with material fresh just as they made it, and used it. Those plates were tested in our laboratory. Some of them were tested here and some of them were tested there, both our grids and their paste. Our laboratory test number was forty-four eighty-seven. The first cells in this test were started on or about April 11, 1913. The last ones were July 22, 1914. In all, around twenty-two cells were tested. We also had reports from Hagen of the tests which they made on the duplicate plates. They sent us some reports as to the results of their tests on these same plates. That is our folder forty-four eighty-seven.

As a result of these investigations and knowledge that I obtained in Germany in 1912 and 1913, which showed that this material was perfectly practical to use, we decided to put in a mill of the German type and in order to put that decision into effect, there was an order issued, what we call a standing order number 452V of May 19, 1915 which reads "All expenses covering building, machinery, etc., in connection with the experimental manufacture of lead powder". Then on

October 18, 1915, purchase order No. 38409 was issued to the Pomeroy Construction Company calling for "Brick corrugated iron building for lead dust mill, erected complete as per your estimate October 15th, 1915 and our drawing SB-288". On May 19, 1915, we issued requisition M-9745 calling for "one special ball mill as per Abbe Engineering Company's Specification dated March 29, 1915, drawings to be submitted and approved before commencing work". That drawing was submitted and this was (indicated by counsel). I have "Defendant's Exhibit 10". There are some further drawings showing the casing surrounding the mill.

I might say that there is one exhibit that shows our drawings taken directly from the German drawings which is turned over to Abbe for them to copy. There is another showing that casing of the mill as we erected it. That is our drawing and beafs date of—

(Counsel for Defendant here offered in evidence as Defendant's Exhibit 14 print numbered SB-201, stamped "Electric Storage Battery Company, factory department, dated 3/11/15" which was received in evidence and marked "Defendant's Exhibit 14".)

(The witness here examined "Defendant's Exhibit 14".).

It is a copy we made of the German drawing. It is very nearly the same, but it is not the same drawing. This is what we turned over to Abbe for them to copy. That is the drawing which we turned over with regards to the mill. "Defendant's Exhibit 14" was turned over to Abbe. "Defendant's Exhibit 10" is the drawing on the larger scale and more detail, the approved drawing from which we purchased the mill. That is my last remarks are addressed to "Defendant's Exhibit 10".

(Counsel for Defendant offered in evidence as Defendant's Exhibit 15, blue print No. SB-286, dated March 23, 1916, which was received in evidence and marked "Defendant's Exhibit 15".)

(The witness examined the drawing.)

This drawing 15 shows the outer casing, the surrounding casing which was installed outside of the Abbe mill. It shows a casing, steel casing, sheet iron casing, which was erected after the mill was in place in the building, and inclosing the mill. The inverted cone-shaped thing near the left center of the page is for collecting the dust that came from the holes of the mill and screen to small boxes, until it could be eventually taken down to the keg underneath. The combined cylinder and inverted cone at the left upper hand corner, is another view of the same casing. This semicircle at the right hand upper corner of the drawing is the upper portion of the casing. The parellelogram immediately below that is the top view of the upper casing. And the large parallelogram in the middle or bottom of the sheet is a top view of the lower half of the casing. All these last questions and answers have been addressed to "Defendant's Exhibit 15".

The mill was completed in the early part of 1916, the exact time of which I have no record but it was early in 1916, before the middle of 1916. The mill was then put in charge of W. E. Kershaw, who was the head of the Research Department. Mr. Kershaw is still with the Electric Storage Battery Company. He is in Court today. Mr. Kershaw is the gentleman who is now about to stand. At that time I gave to Mr. Kershaw all the information and notes and data which I had collected in Hagen and as much explanation as I was able to give him.

We got from the mill this same product of lead

dust partially oxidized, or, as I should say perhaps, a powder containing some oxide of lead and some metallic lead. As nearly as I could tell, it corresponded substantially in every respect with the German lead powder known by them as bleistaub. Kershaw operated the mill and explored its possibilities. He found he was able to vary the degree of oxidation through quite wide limits.

(A note book headed "H-3-16" was here offered and received in evidence and marked "Defendant's Exhibit 16").

This is Kershaw's original note book under date eighth month third, 1916 and shows that he started to run that German mill 235, finish 440, quite a short run. It shows temperature of one hundred and twenty-one degrees, doesn't say whether it is Fahrenheit or Centigrade, fifteen revolutions, gross weight one hundred and fifty-six pounds. There is a special notation, eighth month, fourth, 1916, the next day, a similar notation as to temperature, revolutions, gross weight, stop and so on.

(A page of the note book headed "8-17-16" was here offered and received in evidence and marked "Defendant's Exhibit 17",)

This note discloses that there were fifteen hy cap positive plates stamped LD, 1A, fifteen hy cap positive plates stamped SE-1B, made on that date. It shows that there were sixty pounds of lead dust in small mixing machine and shows the cc of sulphuric acid were added, mixed for ten minutes, made into a smooth paste, easily pasted, pasted on cloth like negatives, and the weights are given. The LD in this nomenclature signifies lead dust. This page, I believe, shows the date of the first plates that were ever made

in this country with lead dust produced in this country according to the process of which we are now talking.

Mr. Kershaw was not under me at that time. He was working as head of the Research Department. One of his special duties was to operate this mill, not the only one. He continued to operate the mill from that time on and there were other notes of the work that he did in the mill. He continued to produce lead dust and make sample plates.

Laboratory test No. 4793-D, was used for the testing of these plates made by Kershaw. It is quite a voluminous test, covering some fifty-seven different cells in all. The first pair of cells in this test were started August 16th, 1916 and the positives of these cells were marked LD-1A and LD-1B, the same plates, in other words as those shown in this record of Kershaw's note book which has just been put into evidence. Test No. 4793-D was continued and added to from time to time. The last cells contained there were started October 18, 1917. Kershaw operated the mill through the balance of 1916 and 1917 and through part of 1918. He has records covering this period.

(The following papers were here offered and received in evidence as here indicated:

Blue print headed "Lead dust mill record of operation for week 8-20-26-16" was marked "Defendant's Exhibit 18-A."

Blue print headed "Record of operation for week 11-5-11-16" was marked "Defendant's Exhibit 18-B."

Blue print headed "Record of operation for week 11-26-12-2-16" was marked "Defendant's Exhibit 18-C."

Blue print headed "Record of operation for week 3-4-10-17" was marked "Defendant's Exhibit 18-D."

Blue print headed "Record of operation for week 5-12-18-18" was marked "Defendant's Exhibit 18-E."

Each of these papers marked "Defendant's Exhibit 18-A to 18-E inclusive which you hand me, covers about a week's operation of the mill. The first one is dated eighth month, twentieth to twenty-sixth, 1916, headed, "Lead dust mill" and "Record of operation" for that week.

The top line curve shows the temperature readings that were taken, the next one the revolutions per minute, the next the lead in drum, the next shows the weight of the balls which are put into the mill, and the weight of the dust which is removed from the mill.

That first sheet, it may be noted, does not give any data as to oxidation of the product. Subsequent ones do.

The next record which I have is dated eleventh month, five to eleven, 1916. That gives the same information which I have already read, except it gives in addition the percentage of PbO contained in the product. Some of these notes I think he made prior to the figures. These figures at the left should be multiplied by ten, as applied to the percentage of PbO. It is so marked on the end, I think. That would give a percentage of material, calculated as PbO of sixty-nine to say seventy-three or seventy-four percent. The sheet also shows that the mill was run for a matter of about two and a half days, that they held the percentage of PbO practically constant throughout that time. It shows the plates—a note at the bottom here, LD No. 25, which means they were pasted 11-16-16, showing the product used from the mill came on that date and was pasted on the plates known as LD No. 25. The Exhibit number of the paper which you have

referred to is 18-B. I am now referring to the next exhibit which is called 18-C. It is dated eleventh month, twenty-sixth, to twelfth month, second, 1916. It shows temperature, revolutions, mill load in the drum, weight of dust per hour and equivalent weight of balls. All these Exhibits 18-A to E inclusive refer to the mill that was installed in Philadelphia as heretofore specified by me. There is a notation there, "Run CIM, lot number 1,794 plates". In other words, it shows 794 plates were pasted with this material and were put through the form department, where they were given this designation, No. CIM. That chart shows the revolutions started at about fourteen and a half per minute and after running half a day, they were reduced to about and kept about at eleven and a half with one jump to something over twelve revolutions per minute. The next Exhibit is, 18-D, which shows the operation of the mill on third, fourth to tenth, 1917. I might say also that the mill did not always run through the full week. In this particular case the mill ran for about two days. That gives substantially the same information as some of the preceding sheets, except it gives in addition the percentage of PbO as approximately seventy-five per cent. Turning to Exhibit 18-E, substantially the same information is conveyed by that chart for the period of weeks beginning May 12th and ending May 18th, 1918. In addition to what I have already said with regard to the making of the plates from this dust, I can say that the plates made from this dust were constantly put on the tests. The dust was used for pasting the plates. They were formed, some of them, by Mr. Kershaw some of them in the regular manufacturing department, and the plates subjected to all kinds of tests.

(Counsel for defendant here offered in evidence as Defendant's Exhibit 19, a letter dated November 28, 1926 addressed to Mr. Steinmetz and signed "GMH", which was received in evidence and marked "Defendant's Exhibit 19".)

This document, D 19, is a departmental correspondence note from Mr. Howard, the head of the laboratory, to Mr. Steinmetz, plant superintendent. It is dated November 28, 1916, and the subject is lead dust positives. I will read it:

"Subject: Lead dust positives.

"Confirming result of our conference on the above subject, we are to make forty-eight hundred MV-Hy cap positives pasted with lead dust to be used in making five sets of 58-MV-29 Hy Cap batteries to apply on New York order No. 70929 for the New York Railways Company.

"The paste is to be mixed according to process Number 23CL, copy herewith.

"Plates to be pickled according to regular process Number 23E1.

"Formation to be according to process Number 30BL, copy herewith.

"Yours very truly,

"(Signed) GMH."

Beginning with the latter part of 1916, which is referred to on the top of page 14 of my notes, I will read the notes, if you wish. During the latter part of 1916, a number of plates were made by Kershaw with lead dust which he had produced, and were sent to New York and put into operation by the New York Railways Company. The earliest reference we have found to these plates is contained in Exhibit 19, which is a note from Mr. Howard directing the factory su-

perintendent to make these plates. Under New York Sales Order No. 70929, Exhibit 20, dated 8 7 1916, seventy sets of fifty-eight MV-29 Hycaps are called for, and another Exhibit, Exhibit 11, shows that the original plan, calling for five sets, was changed, and that twenty-five sets instead of five were coming through, although, as a matter of fact, only twenty were finally installed. Another Exhibit, 21, gives further notes as to these same batteries, and is followed by another Exhibit, 22, from Lesley, of the Operating Department, to Welch, his representative in New York. Exhibits 23, 24, 25 and 26 are copies of other letters all referring to this same lot of lead dust positive plates, showing that the number of batteries was changed several times from the original five sets to a maximum of twenty-five, although only twenty were ever actually sent to New York. Exhibit 26 is a copy of the record kept by Lesley of the operation of the various batteries in the New York Railways Company. A note at the bottom shows that certain sets, marked with "*", had "B" positives in them, and these B positives are those referred to in the Exhibit 20, where they are defined as lead dust positives. It would appear from Exhibit 26 that twenty sets were finally installed, all of which were placed in service early in 1917, and renewed at various times from late in 1917 until the middle of 1918.

In order to get an idea of the magnitude of this order of special lead dust positives, it should be explained that each of the twenty batteries which finally went into service consisted of fifty-eight cells, each cell containing fourteen positive plates, and the whole twenty batteries, therefore, comprised 16,240 positive plates. The batteries were used for operating street railway cars, one battery in each car.

Exhibit 27 is a copy of Sales Order No. 70929 to

the New York Railways Company calling for the seventy sets of batteries already referred to, with the price of $65,838.50 duly noted. Notations on the back give data as to the date of shipment of various sets and show the railroad car by which each set was delivered.

On the 4th of August 1916, an agreement was made between the New York Railways Company and The Electric Storage Battery Company for the maintenance by the latter Company of the seventy special storage batteries of Sales Order Number 70929.

A copy of this contract or certain pages of it, with a letter of transmittal dated September 19, 1917, constitutes Exhibit 28. The original of this contract is in the E. S. B. Company's files. In May of 1918, it was decided to make a further demonstration of the lead dust positives in the service of the New York Railways Company, and this test is authorized and described in Exhibits 29, 30, 31, 32, 33 and 34. The first of these exhibits outlines the way in which the test batteries were made up and gives the identification marks to be used on the plates. These identification marks, however, were later changed, as appears in Exhibit 32, and the lead dust positives were finally marked LJB. Exhibit 33 shows that there were finally shipped 3248 of these LJB positive plates to New York in June 1918. These were put into service at various times from July 1918 up until December 1918, as shown on Exhibit 25, which is Lesley's record of the New York Railways Company. In this exhibit a footnote says that these batteries marked with a cross inside of a square contained the LJB positive plates, as referred to in Exhibits 29 to 34 inclusive and these plates remained in service with the New York Railways Company, although we lost track of them when our contract came to an end.

As a result of the successful demonstration made with lead dust positives by the New York Railways Company, as well as other favorable results obtained from this material in the laboratory, et cetera, it was decided, about the middle of 1918, to dismantle the original lead dust mill in which all of the lead dust thus far had been made, and to send it to the Willard Storage Battery Company in Cleveland, in order to allow them to make independent tests of the process and material.

Exhibits 35 to 38 inclusive are copies of letters in the files of C. W. Woodward, assistant to the general manager, and E. W. Smith. These letters authorize the shipping of the mill, and finally give a list of the pieces which were actually sent. Exhibit 38, the last one gives the price which was finally determined upon as between the Willard Storage Battery Company and The Electric Storage Battery Company.

The mill was installed at the Willard Factory in Cleveland the latter part of 1919, and was in operation during the spring and summer of 1920. The details of this operation are given in Reinhardt's report accompanying his letter of October 23, 1931 to Kwis, Hudson and Kent, which disclosed that the mill was operated for the production of lead dust which was used in the manufacture of commercial storage battery plates.

As a result of the work done by Kershaw, at Philadelphia, and by Reinhardt, at the Willard plant, and of the successful demonstration of the lead dust plates in the service of the New York Railways, it was decided to install a full size plant for the manufacture of lead dust at Philadelphia, the German mill having a very limited output.

In order to carry out this project, C. A. Hall was engaged by the E. S. B. Company, as a member of the

Factory Engineer's staff, in the plant superintendent's department, and to him was turned over all the information and data on lead dust which was available. This, of course, included Smith's German notes and all the records of Kershaw's operations with the German mill at Philadelphia, and the records of plates made from Kershaw's product.

Exhibits 9 to 17 inclusive are specifically among the records thus given to Hall.

After going over the information at hand, it was decided to install a larger mill of the same type as the old German mill used by Kershaw, and as the preparation of plans required a lot of work, a new draughtsman, A. H. Shaw, was engaged by the Factory Engineer's office, who worked on the problem, under Hall's direction for a number of months.

The new mill was to be of the same diameter as the old one, but longer, and perforated with many small holes to allow of diffusion into the mill of the air required for oxidizing the lead surfaces, and also to permit the exit of the oxidized lead powder produced.

Shaw started work July 19, 1920 and by October 15, 1920 completed a series of plans and details of the projected larger mill.

Exhibit 39, dated 10-15-1920, S. E. 2309, is the general assembly of the mill which was thus planned.

Hall, however, almost from the start, after going over the data handled to him, claimed that better results could be obtained in a more economical way by using a Hardinge conical mill, and began discussing it with Smith and Shaw. It was quite a radical change from the German mill, as seen by Smith in Germany, and as operated in Philadelphia by Kershaw, in that the German mill had a perforated shell, while the Hardinge mill had a solid shell. It was well recognized that means must be provided for admitting air to the

interior of the mill, and Hall claimed the air could be better introduced by means of the hollow trunnions of the Hardinge mill, which, due to its conical form, also provided for the discharge of the fine powdered product through one of the trunnions, and thus made the small perforations quite unnecessary.

Recognizing the potential advantages of the Hardinge mill, for the process involved, the Company finally decided to try it out, and accordingly a second-hand mill was purchased from the Hardinge Company, as per Smith's requisition of November 11, 1920, Exhibit 40.

The Hardinge mill was shipped in January 1921, as shown in shipping memo of January 7, 1921, Exhibit 41, and was installed immediately upon receipt according to Shaw's drawing, SF-2427-I, dated 11-14-1920, Exhibit 42.

Means for casting the required lead balls were also provided, so that it was possible very quickly to begin operations.

The installation was completed and the mill started up during January, 1921. It very soon developed that the amount of air admitted to the mill, temperature, rate of feed of lead balls, all had to be measured and controlled so as to produce and maintain its proper balance of the various phases of the process, and to produce lead dust of the required qualtities.

As the mechanical equipment of the installation was perfected, it developed that the Hardinge mill made possible a very wide and definite control of product.

The primary elements entering into the control proved to be:

Amount of air admitted to mill.
Temperature of the interior of the mill.
Load within the mill.

It became evident at once the Hardinge mill was started, that a definite flow of air through the mill must be provided and for this purpose a small blower, that happened to be on hand, was installed. This first blower confirmed the necessity of introducing air but proved insufficient and as a result a new blower was purchased May 5, 1921, Exhibit 43, and at once installed.

This new blower provided for a greater amount and better control of the air, and also improved the working conditions surrounding the mill, since it was arranged to exhaust the air out of the mill instead of blow it in, as had the first blower, Exhibit 44.

To learn about temperature effect, a recording thermometer was purchased January, 1921, as per Requisition L-80224, Exhibit 45.

It was at once installed, with the bulb placed inside the rotating mill, at such a position as to keep out of the way of the balls. This thermometer immediately proved to be of great value, but soon developed the fact that its upper limit of about two hundred and twenty degrees Fahrenheit was too low and hence a new instrument was purchased, April 13, 1921, Requisition L-80283, Exhibit 46, and reading to four hundred degrees Fahrenheit. This instrument gave a satisfactory record within the temperature range that was required.

With the air sucked out of the mill, there was, of course, a small amount of fine dust, and while this was at first simply turned loose into the outside air, it was both uneconomical and possibly detrimental to the health of neighbors. Hence, it was decided to put in a dust collector. Drawing S-80-A by the Sturtevant Company, Exhibit 47, shows the apparatus that was purchased on Requisition 111324, December 26, 1922. Similar collectors have been used on all subsequent mills.

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One of the outstanding features of the Hardinge mill in general is that the material within automatically grades itself, the coarse lumps remaining near the in-feed end, in the cylindrical portion, while the fines collect at the opposite end, and eventually discharge through the hollow trunnion at this point. It was soon found hat this same general characteristic held true when the Hardinge mill was used to produce lead dust, but nevertheless, some pieces, too coarse to be used for battery paste, were discharged along with the fines. To separate these coarse particles from the fine, a circular screen, or "bolter", was attached to the outlet trunnion of the mill, revolving with it, so that the fines were permitted to sift through the screen and drop to a collecting bin placed below, while the lumps passed out of the end of the bolter, where they were collected and eventually returned to the mill. Also a very coarse wire sieve was placed in the hollow trunnion itself, to prevent any stray balls which occasionally get to this part of the mill, from discharging into the bolter.

The whole mill is a little lower at one end, it has a little slant, and that helps the material to pass along through the screen. Then it is pushed by other material coming in. It is mainly the fact that the axis is slightly inclined, towards the discharge end. It might also be noted that early in 1921, when he began cooling the mill with water, Hall was much troubled by the water leaking into the mill, through the seams, but by the end of April, 1921, this had been corrected. By April, 1921, Hall had reached the point where he was able consistently to turn out lead dust from the Hardinge mill, but to standardize upon the quality, a large number of laboratory tests were required, which overtaxed the existing personnel. In order to meet these needs, Howard Stoertz was taken into the employ of

the research department under Kershaw, in April, 1921, and he very soon began systematically to test the product. Exhibits 48, 49, 50, 51, 52, 53, 54, 55, 56, 57 and 58, show that between March 2nd and April 12th, 1921, the Hardinge Mill was constantly, though not without interruption, producing lead dust, in constantly increasing amounts, and with fewer interruptions. These record sheets are, however, incomplete and difficult to decipher, but with the advent of Stoertz, the methods of testing and recording were very quickly perfected. One of the first things Stoertz did was to work out, under Hall's direction, a rapid method of testing the lead dust for its PbO content. This method was completed by early June, 1921, and Exhibit 59, dated June 6, 1921, gives the essentials of the test, which with minor refinements has been carried out by the mill operators ever since, for control of the Hardinge mills. The test is so simple that it may be performed by a man of ordinary intelligence without any special chemical training, and chemical laboratory tests constantly carried out as a check, have shown it to be surprisingly accurate.

As the main principles of operation were now well understood, and a rapid method of test was available, Hall made out a regular log sheet, shown in Exhibit 60, dated June 14, 1921, and in certain subsequent exhibits, which was used from that time on. The explanation of the headings in this log sheet is as follows:

Amperes—Current used in driving the mill.

Product—Weight of lead dust discharged into a steel drum (keg) placed on the platform scale.

Feed—Weight of lead balls introduced into the mill.

Air—The amount of air flowing through the mill in cubic feet per minute, measured by Pitot tube, which was calibrated by measuring the air flowing through a U. G. I. meter.

Apparent Specific Gravity—Weight of a cubic centimeter of lead dust expressed in grams.

Oxidation—there appears to be a slight mistake here in my copy; the temperature is a record of a recording thermometer, whose bulb is placed midway between the mass of moving balls and the shell of the mill at its largest diameter. The bulb was fastened to an iron rod inserted through the feed end of the mill, this rod being rigidly fastened to an outside support. The temperature of the air within the mill is what is recorded but not the temperature of the lead balls.

There is a heading, "Oxidation", here, which has no explanation in this note, but the oxidation is the figure arrived at by the chemical tests noted above, and giving the percentage of PbO in the product. That is, all oxidation was being calculated as PbO. From June, 1921 on, Hall continued to run the mill practically continuously, varying the product at will, keeping accurate records of its characteristics and making it into battery plates to be sure that it was satisfactory. Exhibits 60, 61, 62, 63, 64, 65, 66 and 67, dated June 14, 1921 and December 27, 1921, respectively, are typical of the results obtained. By controlling the variables, he made lead dust, by this time known as gray oxide, with PbO content anywhere between 44 per cent, Exhibit 62, September 26, 1921, and above 80 per cent, Exhibit 63, August 19, 1921. And, moreover, he was able to hold any percentage oxidation desired within those limits.

Mr. Morris: There may be a correction to make at that point in dates, if your Honor please. May we reserve that right?

The dates you have given, that you gave last, were the dates of Exhibits 61 and 62, and, as I understand it, you want the dates of 62 and 63, but we will correct that.

MR. WHITCOMB: Sure, that is all right, sure.

THE WITNESS: They are all within this range of exhibits that I have quoted here.

The witness, resuming, testified: During all the year of 1921, and more especially during the latter part of the year, the lead dust from the Hardinge mill had been constantly used to make battery plates, and these battery plates had been put through formation and subjected to many tests. As a result of this testing of various lots of Gray Oxide, Hall, by the end of 1921, had confirmed the general conclusion of Kershaw that, approximately seventy per cent litharge content was the optimum composition, and accordingly adopted sixty-seventy per cent as his limits; later further narrowed down to sixty-five, seventy per cent. The figure of sixty-five, seventy per cent PbO content has remained the standard up to the present time.

As already noted, as soon as the Hardinge mill started to produce lead dust in quantity, this material was made into plates, which were then tested by the laboratories. Exhibit 68, headed Special Process Number 5065, was issued by the Department of Development and Design, on April 22, 1921, instructing the superintendent's department, to make certain plates with lead dust, under the supervision of Kershaw. This Special Process Number 5065 was subsequently extended by the issuance of forty-two other sheets calling for additional plates, the last sheet, dated October 26, 1922. Upwards of 3,700 motive power plates, and 55,000 starting plates were made under this Special Process Number 5065, and the tests of these plates satisfied The E. S. B. Company that the material made by Hall—slight error, typographical error there—that the material made by Hall in the Hardinge mill was substantially like that produced by Kershaw in the German type of mill, and that it was perfectly satisfactory to use.

By the latter part of 1922, all the product which could be produced by the Hardinge mill (now known as Gray Oxide) was used in standard plate production, but the quantity available fell far short of the total demand. As a result of this condition, it was decided to erect at the Company's Crescentville Works, a new plant of much greater capacity than the single Hardinge mill already in operation. The layout of this plant was completed January 30, 1923, and Exhibit 69 shows the foundation plan drawing, SE-4125-11, dated January 30, 1923. This plan called for four Hardinge mills, which were accordingly ordered on Requisition L-99581, dated November 24, 1922, Exhibit 70. The building for housing these mills, known as building 17, was erected by William Steele and Sons, and was completed, and the mills installed therein complete, so that in July, 1923, production of Gray Oxide began.

No difficulties, other than of a very minor character, developed in the operation of this plant, and its product was at once delivered to the pasting department and used in the manufacture of the company's regular product.

The mills in this plant were installed in accordance with the experience gained from the original Hardinge mill, and included the temperature recording thermometers, and improved arrangement of air blowers, and bag separators. The air was drawn through the mills in the direction counter to the flow of the lead; that is, the air entered the mill at the trunnion where the Gray Oxide passed out, and left the mill at the trunnion where the lead balls entered.

During the first month of its operation, this plant produced 203,350 pounds of Gray Oxide and during the first six months, that is up to December 31, 1923, it produced 3,602,000 pounds.

The new plant for producing Gray Oxide had hardly been completed before it was realized that it would not be able to supply enough material for the requirements of the manufacturing department. Hence, it was decided, in the latter part of 1923, to increase it. Accordingly plans were drawn up for extending building number 17, this extension to be known as building 17-A; William Steele and Son's drawings dated November 26, 1923, Job 840, Sheet 1, Exhibit 71 and number 850, dated May 12, 1924, Exhibit 72, show this projected building. From experience that had been gained in the operation of the Gray Oxide mills in building 17, it was decided to relocate the four original mills so as to make the whole layout harmonize. The four mills for this new building were ordered January 17, 1924, requisition L-120560, Exhibit 73. The extension was originally planned for two mills but this was changed and the extension was finally put up for four additional mills, Exhibit 72.

Up to this time, air current through the mills had been in the counter flow direction, as in the original Hardinge mill. In October, 1923, the old Hardinge mill, originally installed at 19th Street, was removed to Crescentville and tests were conducted upon it with the direction of the air flow reversed, so as to coincide with the flow of the product. At the same time, experiments with a much larger size of ball; namely two inches in diameter. Both of these experiments proved successful, so that the eight mills of the larger plant were all arranged to use two inch balls and to have the air flow in the direction of the product. The change in direction of the air flow was a matter of mechanical convenience only and had no effect upon the product or the operation of the mills.

The four new mills were erected and put into operation in August, 1924, using the two inch balls, while

the four original mills were still using the five-eighth inch in their old location. The old mills, however, were moved as soon as possible after the new ones were installed, and were in operation again by January, 1925.

For a number of years, the Hardinge Company worked on a scheme of air flotation whereby the dust produced within the mills was blown out of the mills by a strong current of air entering through the trunnion at the discharge end of the mill. The dust laden current of air issuing from the discharge end of the mill was carried through a number of separating devices and there deposited, the air between being discharged to the atmosphere through a bag collector. This plan seemed to have some recommendations, hence it was decided by the E. S. B. Company to try it on the old secondhand mill the first one purchased from the Hardinge Company. Accordingly, this mill was sent back to the Hardinge Company to have a larger trunnion fitted at the discharge end. Accordingly, requisition 2242, dated December 23, 1923, Exhibit 74, was issued to the Hardinge Company, for changing the mill and furnishing the necessary collecting apparatus. When the mill came back, it was promptly erected, with the cyclone, collector, etc., as furnished by the Hardinge Company, and a number of tests were made. However, the operation of this apparatus was never successful, although considerable time and expense had been put on it, and it finally had to be completely abandoned. It may be of interest to note that this mill may still be seen at Crescentville, building 17, when it will be noted that there were never any holes drilled through the shell. This bears silent witness to the fact that from his first inception of the use of the Hardinge Mill, in July, 1920, Hall clearly planned to maintain the necessary oxidizing atmosphere within the mill by means of the hollow trunnions.

During the latter part of December, 1934, it was decided to duplicate the original lead dust-mill which had been used by Kershaw at Philadelphia. A mill of this kind was available at the Willard plant, in Toronto, having dimensions within a fraction of an inch of the older mill, the installation being such that a few minor alterations of casing, et cetera would make it identical. The arrangement of perforations in the drum of the mill, however, was slightly different from that of the old mill, but by boring some extra holes and plugging up some others, which were of a different diameter, the original conditions could be duplicated. These various changes were accordingly carried out, and in the latter part of December, 1934, the mill was ready for operation. The dimensions and all appurtenant data as to this mill were most carefully checked by Hall, Kershaw and Smith, of The E. S. B. Company, and Reinhardt and Lockwood of the Willard Company, with the result that the Toronto mill was found to be practically an exact duplicate in every respect of the German type mill used by Kershaw in his operations of 1916 to 1918. The mill was erected on an elevated platform exactly as was the mill at Philadelphia and a ventilating pipe was installed from the casing up through the roof of the building so as to reproduce the ventilating arrangement of the Philadelphia mill.

Since the object of this test was to duplicate the old mill, both as to the installation and operation, it was put into the hands of W. E. Kershaw to operate in exactly the same way as the old mill, so far as humanly possible, and in order to better enable him to do this, he took with him to Toronto, Benny Shablin, who had helped him throughout in operating the mill at Philadelphia in 1916, 1917 and 1918. The mill was accordingly put into operation, running day and night, and on December 20, 1934, its operation had settled

down to the point where Kershaw was satisfied that its working was exactly like that—

Mr. Betts: May it please your Honor, I hesitate to object, but it seems to me that a large amount of this material that the witness is reading is clearly hearsay and not admissible. If it were by question and answer we certainly would have to object:

I was there during the operation of this mill. We were all satisfied.

The Court: Well, I wonder if it makes much difference what Mr. Kershaw's feelings were.

The Witness: He can testify to that, he is here. Mr. Kershaw is in the room, he will be glad to testify to that.

Mr. Morris: I don't think there is anything there about his feelings.

Mr. Whitcomb: There is one other place, though, he said it was the same thing it was humanly possible to make it, and yet he points out certain differences. There are certain conclusions of the witness going in here that in our opinion get to the patent end of it. We ought to have an objection to all those.

The Witness: I am not aware of having any differences.

Mr. Whitcomb: You pointed out about the stack.

The Witness: I said it was to have it like the other, not different.

(The following documents, heretofore offered in evidence and referred to in the foregoing testimony of the witness, were here received in evidence and marked as Defendant's Exhibits as indicated subject to objection by plaintiffs after opportunity for examination:)

Letter dated December 9, 1916, from G. M. H. to Mr. Hodge, entitled "New York Railways Company", was marked Defendant's Exhibit number 20.

Memorandum from Department of Development and Design dated February 17, 1917, entitled "Lead Dust Positives for New York Railways Co." was marked Defendant's Exhibit number 21.

Letter dated June 21, 1917, from Lesley, of the Operating Department, to Mr. Welcke, entitled "New York Railways, New Contract—Special Positives—Close Ribbed Wood Separators" was marked Defendant's Exhibit number 22.

Letter dated December 1, 1916, from the Manager of Construction Department to Mr. R. S. Garton, entitled "New York Railways, N. Y. Order #70929" was marked Defendant's Exhibit number 23.

Letter dated December 2, 1916, from Manager of Construction Department to Mr. R. S. Garton, entitled "New York Railways, N. Y. 70929" was marked Defendant's Exhibit number 24.

Letter dated December 14th, 1916, from Operating Department, Engineer-in-charge, to Mr. Welcke, entitled "New York Railways Co., New Contract—Deliveries — Special Positives", was marked Defendant's Exhibit number 25.

Record of battery operation in the New York Railways Company was marked Defendant's Exhibit number 26.

New York Sales Order No. 70929, dated 8-7-1916, was marked Defendant's Exhibit number 27.

Letter dated September 19, 1917, from D. W Ross to The Electric Storage Battery Company, and copy of Agreement between New York Rail-

ways Company and The Electric Storage Battery Company was marked Defendant's Exhibit number 28.

Letter dated May 3d, 1918, from Department of Development and Design to Mr. Lesley, Operating Department, was marked Defendant's Exhibit number 29.

First sheet of letter dated May 6, 1918, from Manager of Construction Department to Mr. R. S. Garton, was marked Defendant's Exhibit number 30.

Second sheet of letter dated May 6, 1918, from Manager of Construction Department to Mr. R. S. Garton, was marked Defendant's Exhibit number 31.

Letter dated June 3rd, 1918, from Department of Development and Design to Mr. Lesley, Operating Department, was marked Defendant's Exhibit number 32.

First sheet of memorandum dated June 13, 1918, from Operating Department to Mr. Hodge, entitled "New York Railways Co., Special Positives and Negatives", was marked Defendant's Exhibit number 33.

Second sheet of memorandum dated June 13, 1918, from Operating Department to Mr. Hodge, entitled "New York Railways Co., Special Positives and Negatives", was marked Defendant's Exhibit number 34.

Letter dated July 12, 1919, from The Electric Storage Battery Company to Mr. E. W. Smith, entitled "Lead Dust Mill", was marked Defendant's Exhibit number 35.

Letter dated August 14, 1919, from The Electric Storage Battery Company, to Mr. E. W. Smith, entitled "Lead Mill", was marked Defendant's Exhibit number 36.

Letter dated August 14th, 1919, from Factory Engineer, The Electric Storage Battery Company, to Mr. Woodward, was marked Defendant's Exhibit number 37.

Letter dated October 16, 1919, from The Electric Storage Battery Company, to Mr. J. P. Fitzgerald, entitled "Lead Powder Mill, Willard Storage Battery Company", was marked Defendant's Exhibit number 38.

Blue print entitled "Assembly of Dust Machine", dated October 15, 1920, was marked Defendant's Exhibit number 39.

Requisition No. L59725, dated November 11, 1920, was marked Defendant's Exhibit number 40.

Shipping memorandum of Hardinge Conical Mill Company dated January 7, 1921 was marked Defendant's Exhibit number 41.

Blue print entitled "Layout of installation of Dust Machinery", dated November 14, 1920, S. F. 2427-1, was marked Defendant's Exhibit number 42.

Requisition No. L81510, dated May 5, 1921, and letter from American Blower Company to Electric Storage Battery Company, dated May 5, 1921, were marked Defendant's Exhibit number 43.

Requisition No. L80224, dated January, 1921, was marked Defendant's Exhibit number 45.

Requisition No. L80283, dated April 13, 1921, was marked Defendant's Exhibit number 46.

Drawing No. S-80-A, entitled "'Dust Collecting Arrangement for Electric Storage Battery Company", was marked Defendant's Exhibit number 47.

Memorandum dated March 2, 1921 was marked Defendant's Exhibit number 48.

Chart No. 685, entitled "Bristol's Recording Thermometer, dated March 2 and 3, 1921, was marked Defendant's Exhibit number 49.

Memorandum dated March 4, 1921 was marked Defendant's Exhibit number 50.

Memorandum dated March 16, 1921 was marked Defendant's Exhibit number 51.

Memorandum dated April 8, 1921, was marked Defendant's Exhibit number 52.

Memorandum dated April 9th, 1921 was marked Defendant's Exhibit number 53.

Memorandum dated April 11, 1921, made by Trimble, was marked Defendant's Exhibit number 54.

Chart No. 685, entitled "Bristol's Recording Thermometer", dated April 11, 1920, was marked Defendant's Exhibit number 55.

Memorandum dated April 14, 1921 was marked Defendant's Exhibit number 56.

Memorandum dated April 15, 1921 was marked Defendant's Exhibit number 57.

Memorandum dated April 12, 1921 was marked Defendant's Exhibit number 58.

Memorandum dated June 6th, 1921, entitled "Approximate Method of Determination of PbO in Lead Dust", was marked Defendant's Exhibit number 59.

Daily report of operation of Hardinge Mill, consisting of two sheets, dated June 14, 1921, was marked Defendant's Exhibit number 60.

Daily report of operation of Hardinge Mill, consisting of three sheets dated September 26, 1921 and three sheets dated September 27, 1921, was marked Defendant's Exhibit number 61.

Daily report of operation of Hardinge Mill, consisting of two sheets dated August 19, 1921 and

one sheet dated August 20, 1921, was marked Defendant's Exhibit number 62.

Daily report of operation of Hardinge Mill, consisting of two sheets dated December 6, 1921, was marked Defendant's Exhibit number 63.

Daily report of operation of Hardinge Mill, consisting of one sheet dated October 6, 1921, was marked Defendant's Exhibit number 64.

Daily report of operation of Hardinge Mill, consisting of one sheet dated November 18, 1921, was marked Defendant's Exhibit number 65.

Chart showing operation of Mill, consisting of one sheet, dated September 28, 1921, was marked Defendant's Exhibit number 66.

Chart showing operation of Mill, consisting of one sheet, dated December 27, 1921, was marked Defendant's Exhibit number 67.

Memorandum entitled "Experimental Shop Process", dated April 22, 1921, to Mr. Howard from Department of Development and Design was marked Defendant's Exhibit 68.

Blue print, SE-4125-11, entitled "Foundation Drawing of Four Hardinge Mills to be Installed at Crescentville", dated January 30, 1923, was marked Defendant's Exhibit 69.

Requisition No. L99581, dated November 24, 1922, was marked Defendant's Exhibit 70.

Drawing No. 840, entitled "Plans—Elevations—Sections" dated November 26, 1923, was marked Defendant's Exhibit 71.

Drawing No. 850, entitled "Plans—Elevations, Building No. 17-A", dated May 12, 1924, was marked Defendant's Exhibit 72.

Requisition No. L120560, dated January 17, 1924, was marked Defendant's Exhibit 73.

Requisition No. 2242, dated December 23,

1927, and letter dated December 23, 1927 to Mr. Gold, were marked Defendant's Exhibit 74.)

The witness, resuming, testified: The mill was kept running at Toronto in December, 1934, for approximately three days, I believe. On December 20, it was operated up to the early afternoon, two or three o'clock, as I remember. The material was put into tin cans, which were afterwards carefully sealed and sent back to Philadelphia. May I make a suggestion? On the second run of the mill, where these gentlemen from the plaintiffs were present, the test of the material so produced was done. I wonder if that is not the one you have in your hand. Some of the material made on this first run was sent to Philadelphia in sealed tin cans, was there delivered to Mr. Kershaw and was made by him into plates in exactly the way he had used his former material made in the Philadelphia mill. I observed the results. As near as I can possibly tell, the results were the same as those that were had by the oxide produced by Kershaw in 1916, 1917 and/or 1918. There was a second run of the mill at Toronto made in January, 1935. I have no doubt that is the correct date. On January 11, Messrs. Whitcomb, Betts, Ishimura, Yamoaka, Newton, Wood, Reid, Souther, Wilson, Stoughton, Woodbridge, Kershaw, Anderson, Lockwood, and Hall were present to witness the operation of the mill. They were all in Toronto. I wasn't there. This Toronto mill was not a Hardinge mill. It was a duplicate of the German mill.

Mr. Morris: It was an exact reproduction, so far as we know, of the German mill as used by the Electric Storage Battery Company in Philadelphia in 1916, 1917 and 1918. The drawings of the old German mill, the German mill will show no flue running from the top of the mill, but I shall show you by Mr. Kershaw and by another man whose name I forget at the mo-

ment that that stack, or flue, let's call it a stove pipe in appearance, was put on probably in August, 1916, and our log sheets or some of them will show that in early 1917 the dampers in the flue and the leg, discharge leg, at the bottom were being operated to control the air.

The witness, resuming, testified: A number of the samples taken at Toronto on January 11, 1935, were delivered to the gentlemen representing the plaintiffs. Other samples were sent back to Philadelphia and the material there was used in the making of plates. Dr. Wilson, I believe, also took some samples. The object of this test was as follows. The tests made by Kershaw in 1916 and thereafter were a long way back. Our records as to that material covered specific gravity, oxidation. We had not at that time the means of testing materials which have since then been developed. We wished to get some material which would be representative of that older material, as near like it as humanly possible to make it, and subject that to the modern tests so as to ascertain exactly what this, what that older material really was, and whether it came within the description of the Shimadzu patents.

(Counsel for defendant thereupon offered in evidence as Defendant's Exhibit 75 a sealed tube containing a sample of powder from the Toronto mill bearing Dr. Wilson's initials, which was received in evidence and marked Defendant's Exhibit No. 75.)

THE COURT: Well was this mill commercially operated?

MR. MORRIS: At Toronto?

THE COURT: Yes.

MR. MORRIS: Oh, no, it was set up purely for the purpose.

THE COURT: No, that is what I mean.

MR. MORRIS: No, it was purely for the purpose—

THE COURT: Just as an exhibit.

MR. MORRIS: —of reproducing—

THE COURT: I say, just as an exhibit for this case, really.

MR. MORRIS: That is all, solely. I think it may be that some of the plates that we made—

THE COURT: Well,—

MR. MORRIS: But I don't know that those ever—that we did anything about them.

The witness, resuming, testified: As near as we are able to ascertain, the material obtained at Toronto was almost exactly the same as that produced in the German, in the old perforated mill in 1916, in Philadelphia. Its oxidation was the same, its specific gravity, apparent specific gravity was the same, within the variations that both of the products had, it was pasted into plates, and made plates which were in all substantial respects the same and the equal of those produced in 1916 and 1918. Its features were the same. It was pyrophoric, it would burn, not with very great readiness, but it would burn if you set fire to it with a match. Its fineness, as near as we know, was the same. Everything about it as near as we know is thoroughly characteristic of the earlier material.

I remember of my own personal knowledge that a ventilator, a stack or chimney, was placed above the old mill, perforated mill, in Philadelphia, that we were using in 1916, 1917 and 1918. The stack was placed from the casing of the mill right directly up through

the roof of the building. It was rather a small pipe, small stove pipe.

Cross-examination.

By Mr. Whitcomb:

Practically speaking, all of the testimony that I have just given was of my own direct personal knowledge. I wasn't at the second Toronto test. I did know about it. But I wasn't there. I had direct knowledge in that Mr. Hall, who was there, is my assistant. I haven't direct personal knowledge. That applies to a few portions of the written document from which I read. I know of my own knowledge fifty per cent of it, from personal contact. When the mill was dismantled and sent to Cleveland, I did not accompany the transporting of the mill. I had to do with its being set up in Cleveland only that I furnished directions as to how it should be set up, blue prints. I think I never saw the mill in Cleveland.

(Counsel for Defendant moved to strike out all of that testimony.)

With respect to the mill in Toronto, The Willard Company had this mill in operation. That was not the mill that was shipped to Cleveland originally. This is a different mill. The Willard Company operates the Toronto plant. They also operate the Cleveland plant. They have two plants. This was a mill that they had set up and were operating in Toronto. They operated it in a different way. It required very slight structural changes to bring it in a line with the German (mill). So, to make our experiment, we took the Toronto mill, which was in commercial operation, and changed it somewhat to what we thought was the German mill, to correspond with what we had in Philadelphia in

1916, 1917 and 1918, the German type of mill. In my discussion as to when Mr. Hall entered the field in connection with this Hardinge mill, I talked about the requirements for the air being introduced. I meant by that that it was well known by that time that air was required inside of the drum of the mill to oxidize the balls. Hall filed an application for a patent, I testified in his behalf in an Interference in support of his contest with Shimadzu as to the very issues in some of these claims here before the Court. It was well known that air had to be introduced to make the process work. The amount of air was not very definitely known. Hall introduced the air. I testified on direct that that question of air balance and amounts of air was very important. If you don't have sufficient air, you get a much reduced product and of a lower oxidation. I mean by reduced product, reduced in quantity. If you get too little air, you get very little yield. If you don't have any air, as has been testified here, you don't get any product. I can't tell you what amount of air Hall used in his first installment of the Hardinge mill. I have no measurements of that. I think I did not testify in the Interference that he had enough air to blow the material out. I haven't that before me, but to the best of my recollection that is not correct.

(The Interference Record was here shown to the witness.)

In XQ80 in the Interference procedure, I testified that some of the powder runs out and some is blown out. I was referring to Hall's material. I would have to go back over this Record a little to see just what it is getting at. As to whether that is a correct statement of what I said, it is printed there, it is perfectly clear that I said it. To the question XQ87: "Yes, so far as blowing the stuff through the mill is con-

cerned?", it is correct that I made answer at that time: "So far—yet, that is correct, it is indefinite as to what, how much was blown through, in both cases." It is not my opinion now, that he had enough air to blow some of the material through. Since that time more information has come to me, as we have made tests on this effect of air blowing so we know more about it than we did at that time. Undoubtedly, some comes out with the air, still, if that is what you wish me to say. Where you have a current of air and dust in the material necessarily some comes in the air. It is in no way a vital process of the mill, however. This was the thing that Hall changed over the prior mill, when he introduced the Hardinge mills that I have just testified to this afternoon.

The main differences between the Hardinge mills started in 1920 and the prior alleged installation in 1916, are that in the earlier mill the air entered the mill and left the mill by the holes in the perforations in the drum. I said that Exhibit 15 represented the casing around the installation in 1916. That is the top of the casing in the upper left-hand view. There is no opening through there for air. I testified in the original German mill it leaked. In the original Philadelphia mill it also leaked, until a pipe was put in, a ventilating pipe, to increase and better control that flow of air through the casing. That is what we had in Toronto, and we had at some time in Philadelphia. As first erected, the apparatus shown in Exhibit D-15 didn't have a vent pipe. Kershaw soon put such a pipe on, as he will testify for you. The difference between the operation of the air in the German type of mill, first installed in the Philadelphia plant, and in Hall's Hardinge mill, was that in the original installation of the German type of mill the air flowed up through the casing, out through the cracks. I never measured it,

but I have seen the current, seen that there was a current in the bottom of the pipe, so I know there was a current there due to the heat. There was no fan or forced draft. Hall introduced the air—you asked me all the differences, so I will go back.

One was in the method of getting the stuff out, getting the product out of the mill. The other was the difference in getting the air in. In the original mill the powder came out through the holes, the air went in through the holes. In Hall's mill the powder was discharged by the conical mill, conical part of the Hardinge mill, according to its well-known operation, and the air was introduced through the hollow trunnions, in one and out the other. That is, I mean, according to this conical effect at the outlet end of the Hardinge mill, as shown on the drawing attached to Dr. Wilson's report. This does not have an aspirating or jet effect. The Hardinge mill in general discharges at the lower end without any aspirating effect. It has a cone, narrowing effect; but it has no aspirating effect. The velocity is higher in the trunnion, of course. It does not expand appreciably after it gets in the screen chamber, because it is not compressed. The velocity changes. The carrying power of these particles of dust is due to the fact that the mill is conical, and that the axis of the mill is on a slant, the mill is not horizontal, so every time a particle is carried up on the cone, it is dropped a little further away. I am not saying that no material goes through by reason of the air, but I am saying for the large part of it, while Hall operated these mills, the air went through in the opposite direction and the mill discharged contrary to the flow of air. Now there is no contrary motion in the present installation as shown by the print attached to Dr. Wilson's report. I believe it is correct that in the first Hardinge mill that Hall installed, the air went the

other way. I would have to check very carefully on that. I testified on direct examination that as to the first mills that were set up at Crescentville, it went the other way. In the Crescentville mills originally installed, air was blown through in the opposite direction. Hall put up the first Hardinge mill at 19th Street. When I testified positively, I testified as to the Crescentville mills. I will check up on the first installation. I haven't got the information before me right here. If I can clarify the situation, we have run mills with the air in both directions, at different times. It is probably correct that in the 19th Street first installation of the Hardinge mill, the air went in the counter direction, but I haven't the information at hand other than that. It has been some years since I made any check up on it. My memory doesn't serve me absolutely as to just which way. The air in the mills at the Exide plant now flows in the same direction as the material, as would be the case in the showing on the Shimadzu apparatus patent in suit, except that the internal arrangement is totally different. But the direction of air is the same. The direction of the air in the exit trunnion is the same. In connection with this drawing attached to Dr. Wilson's report of the Exide mill, the screen is also inclined.

Hall was employed in 1920 to work under my direction in the installation, the planning and the building and operating of a larger plant for the making of lead dust. We were satisfied with the output of the machines in the old installation of the German type. We did not continue to use them. Our reasons for discontinuing them were that we found that the Hardinge mill gave us somewhat better control of the process and also gave us better output. The Hardinge mill as at present operated is a much larger mill. I don't know whether I have a basis of comparison of

output or not. I haven't any accurate data as to what the German type mill produced, as operated by Kershaw. That we can get; I don't happen to have it before me. As regards Kershaw's work, Kershaw did not work under my direction and it is correct that I haven't such direct information as to his work as I have with the later work. That applies to these curves I produce, that is Exhibit D-18. Kershaw will have to testify to those curves. Those are Kershaw's curves. He will give you full information on that. I recollect no difficulties experienced with these types of mills that Mr. Hall worked on when he first started the Hardinge installation in the 19th Street place, other than such mechanical difficulties as breaking of belts and sticking of bearings, and the difficulties that are common when new machinery is installed. It naturally took some little time to learn exactly how to operate the mill to control it. I did testify in the Interference previously referred to that I would say that it took, roughly, some six months to eliminate the difficulties occasioned by leakage of water in the Hardinge mill that Mr. Hall installed, if it is in the testimony. It is roughly the case. I have already mentioned that Hall had much difficulty with water entering the mill, this afternoon I mentioned that. The water came from leaks through the seams of the mill and in the manhole. It was the cooling water, to cool the mill. It took us a long time to find that out. I have mentioned that already in this afternoon's discussion. You asked me just now if there were any difficulties other than those I had mentioned, and I had already mentioned the difficulty with water in my previous testimony this afternoon. I did not say in direct-examination that that was a minor thing and immediately overcome. I think I said it took some months. I don't remember. It caused us a great

many arguments and we had a good deal of difficulty before we actually found what it was. It manifested itself chiefly in the formation of a ring of hard litharge on the inside of the mill, and in such a way as to clog the output, so that the stuff did not run out, and it was a long time before we were persuaded that it was water leaking through the seams which caused the formation of these rings, and that, I think, was brought out in the former testimony as well as in today's.

Maintaining the correct temperature is very important. The cooling produced by some external agency is important in that respect. Regarding the reactivity of the material my testimony is not quite to the same effect as Mr. Cooper's was yesterday with respect to material around the plant. The material which we ordinarily make, as standard material, if you pour it out onto a table or anything else, will not burn if you touch a match to it. Cooper's testimony was that sometimes the material direct from the mill while it was hot fell into some drums which were wet, and that it caused steaming. I am not familiar enough with that particular form, with that particular incident, to know whether what he spoke of on that is correct or not.

As to the samples of the 1921 Hardinge mill, the samples were of all ranges of reactivity. Some of them were extremely reactive and others were not, according to how they were made. Some of them would burn very readily when you touched them with a match. Others would not. The composition of our material varied over wide limits, until we finally arrived at the one which we considered the best suited to our purpose.

I have mentioned the formation of PbO. As to whether there was any other oxide made in the operation of the Hall 1921 mill, I can give you a great many

opinions, but when you come to pin me down for direct knowledge, I can give you none. My personal opinion at the present time, in view of many tests that have been made by other people, and whose evidence I am taking is that there was no such other oxide, either inside the mill or as the product came out of the mill. In the interference, I testified that there might be suboxide. Since the date of those tests, there has been a great deal of new light thrown upon it. I wish you to understand that I am giving you my opinion; I didn't say that there cannot possibly be any suboxide in there. I started this question by telling you that I didn't know, I would be glad to give you my opinion.

THE COURT: Well, what did he say in the Interference proceeding?

MR. WHITCOMB: On page 347: "I know that Hall produced it in his mill." The question is:

> "What if any knowledge have you as to the manufacture prior to March, 1924, of lead powder, the contents of which is metallic lead and lead suboxide, the later in major proportion?"
>
> "A. I know that Hall produced it in his mill, in his Hardinge mill, in whatever quality he wanted, made it in large quantities."

The witness, resuming, testified: Do you mind my saying it is now my opinion that there is not any other oxide in it? A great deal of light has been thrown on that subject between that time and this. That is, from the experts I have consulted and those that you have, also. I think the two are substantially alike. My opinion is that they are alike. I haven't the least idea whether or not there is a transformation from one stage of oxide to another in the mill. I have no recol-

lection as to whether I did state that there was in the interference, but if it is written in the book, I no doubt said it.

There may have been glass peep holes used in some of the mills that Mr. Cooper testified about at times. Whether they were there during the time he was there, I have no recollection. At times, we have had glass holes, glass plates, to look into the mills, but they get clogged very quickly and are not very successful, not much use.

The five so-called well-known oxides of lead that were spoken of in Hall's patent, which are given in all of the chemistry text books, up until very recently, if not of today, are lead suboxide, lead monoxide lead sesquioxide, red lead, and lead peroxide. The symbol for the sesquioxide is Pb_2O_3. Red lead is Pb_3O_4. I am not willing to swear positively that there is Pb_2O_3. You asked me what they were. I answered that those are the oxides that are given in the textbooks. I am not going to swear that there is such a thing. There is not any Pb_2O_3 that I happen to know of.

My testimony that the product of the Toronto run was the same as the old product that was gotten in the mill in 1916, 1917, 1918. I will go this far, that the apparatus in which it was made was exactly the same, as nearly as we could make it, humanly possible, that the two pieces of apparatus were run as nearly the same as possible, humanly possible to run them, and, the effect, we had the identical people trying to produce the same—the tests which were made of the product, chemical tests, oxidation tests—I didn't make the tests myself. I know only through these records. As far as my direct knowledge goes, it doesn't extend to the chemical composition of the product, except I have access to the work that has been done. I have to take somebody else's word for it. As far as my di-

rect personal knowledge of that product is concerned, it is limited to the appearance and the way the product feels to the touch, and the weight and so on, the physical characteristics, in other words. That is what I say about this. I don't know of my own knowledge, I don't offer any testimony as to the chemical composition of the product. In answer to your question as to whether I felt it with my hands, I wasn't there the second day of the run.

By Mr. Whitcomb:

Q. You have already testified that you previously testified in the Interference record. Please state whether or not on page 353 of that record in the Court of Appeals the following questions and answers occur:

"Q. If I tell you that the product to which 44 related was related was dark in color, and made by the Hardinge mill operations, could you state in regard to such a product anything about its contents of suboxide of lead and metallic lead, and about the proportions of those substances?

"A. I could, yes.

"Q. Well, what would you say?

"A. An oxidation of forty-five per cent—

"Q. Well, I took 44?

"A. 44 per cent, quoting from memory, corresponds to about eighty-five per cent suboxide.

"Q. And what else, if anything?

"A. And the balance chiefly lead.

"Q. And the balance what?

"A. Chiefly metallic lead.

"Q. What is the meaning of the qualification 'chiefly' there?

"A. Well, there might be traces of oxide, other oxide.

"Q. Such as what?
"A. PbO."

And on page 429, in answer to question XQ99, you state in part: "Now, if you desire to produce a powder containing a large percentage of lead suboxide you must run the mill at a much lower, at a lower temperature, at a suitable temperature."

And again, on page 430, further answering the same question, you stated: "It is also well known specifically that lead suboxide is destroyed and further oxidized if it reaches an elevated temperature approaching the melting point of lead, so to get a large proportion of suboxide of lead you must run the mill at a considerably lower temperature than Hall gives as his limit, as his high limit."

. . . . . .

Q. On page 436, XQ122:

"Suppose you used two hundred and sixty, would you get less suboxide—the other two factors being the same?

"A. Yes—you would get a little less.

"Q. How much less, what proportion?

"A. I can't tell you how much less.

"Q. Well, would it be materially less?

"A. Well, I can't tell you how much less, no, not very materially, I think. When you get up to three hundred there would be materially less."

Then, again, in answer to XQ125, the question was, "Yes"; your answer was: "Control of the temperature is vital."

"Q. Yes. With your experience could you take a Hardinge mill and without experimentation run it so as to get a preponderant quantity of lead suboxide.

"A. Not without some experimentation, I couldn't; with some experimentation I could."

Are those substantially correct

A. I believe they are, sir.

The witness, resuming, testified: I am a chemical engineer. When I testified in the Interference proceeding, I testified from something besides mere guess. I think this answer will clear that up. I am now reading from page 370 in answer to RXQ153. My answer to that was: "You can determine it if you accept the use of the word suboxide as we have been talking about it here, and as all of these tests describe it, that is, of its burning freely in the air, and all of the other tests that have been cited here, make it plain as to what suboxide it is." It is suboxide that I am referring to when I say "Yes", we can make it, if I may enlarge on that a little further. I have no other reference.

By Mr. Whitcomb:

Q. But on page 371, right there, what did you say in answer to XQ158, which was:

"I didn't ask you about tests that you made, but I say those figures of themselves, without the tests, without other tests, would not indicate to you at all how much litharge or how much suboxide is there?"

What was your answer?

A. My answer was:

"Well, I think you make it a little difficult. When I say those figures, without personal background of knowledge, to a person who is not a chemist, they mean nothing; to a person who has studied this problem in a chemical way they mean a great deal. Now, with the background that we have of knowing about this material, they mean a great deal."

The witness, resuming, testified: By the word "we" there, I meant to include myself, and I meant to refer back to the definition of suboxide which I gave a few questions further back. I meant a hypothetical substance which had certain physical characteristics, exactly that. That is as far as I meant to go.

By Mr. Whitcomb:

Q. But you don't deny that you said in answer to the question I read yesterday that you knew that Hall had suboxide, do you?

A. That is written in the record, that is perfectly plain, sir.

I read from some thirty pages of notes yesterday. Those notes were prepared at various times. Going back, some of them, a number of years, and some of them cut down, rewritten, so that the preparation of those has been over a considerable space of time. I was reading from some material that I had written several years ago, that is correct. In reading many of those facts from this paper, I was refreshing my memory, with notes that I had made earlier. I have an independent recollection of most of them. I haven't an independent recollection of everything that happened thirty years ago, or fifteen or twenty years ago. Those notes were not prepared as long ago as twenty or thirty years. I don't know what the date at the top, June 1, 1934, means. If you will show me the thing I may be able to tell you. (The notes were shown to the witness.) I don't know what that means; probably the date this particular copy was made. I didn't dictate that particular sheet. I prepared the notes but I didn't preaare sheet one. If you will let me look at sheet 2, I will tell you whether or not I prepared it. I didn't prepare this particular copy of any of these notes, if that is what you mean. They were prepared

under my supervision. Counsel had something to do with preparing them, and our patent expert, Dr. Woodbridge. I was in frequent consultation with our counsel here, Judge Morris and Mr. Stoughton. They, however, did not help in the preparation to any material extent. I said I didn't prepare this particular copy. I prepared the material from which this is made. I do not know where this sheet was typewritten. I didn't have it typewritten myself. I think sheet 2 was prepared here in Easton, Pennsylvania, but I am not sure. I don't know whether it was or not. I don't know where that particular sheet was written. I don't know where sheet 2 was written. I know some of them were written at Easton. Whether they were all written at Easton I don't know. I can possibly tell. (The witness examined the notes.) This thing has been gone over a number of times, and just where all the pages were prepared, were written, I can't tell you. I don't know where all those particular pages were written. I know that some of them were written here; whether all of them were I cannot be sure.

Q. For instance, on page 9 I see a reference to the vent pipe, the word "small" vent pipe that was supposed to have been installed on the A. F. A. Philadelphia mill is crossed off. Who crossed that off?

A. I don't know who crossed it off.

I don't know whether I read that into my testimony yesterday. You will have to look at the testimony and see. That is my writing. I don't know when I wrote it in—recently, I don't know when.

(Notes of the witness, Smith, entitled "History of the Development of lead dust (later called Gray Oxide) and its use by the Electric Storage Battery Company" were marked Plaintiffs' Exhibit number 42, for identification.)

Referring to Exhibit D-3, those notes, dated August 30, 1907, are in my handwriting. I wrote that on the date given. The process outlined to me was quite new at that time and it was in actual operation. I believe it was satisfactory.

THE COURT: What process, now, are you speaking about, the Hardinge mill?

MR. WHITCOMB: No, the early one he learned in Berlin.

THE COURT: I see, all right.

MR. WHITCOMB: Or Hagen, pardon me.

Perhaps I can help you read my writing. Part of the note states: "It is rather a delicate process and sometimes the product is not controllable at all." I don't know that I can make it much plainer. It was new, and I think, as in all storage battery processes, you sometimes get scrap, you sometimes get some stuff there that wasn't good, sometimes burned in the drums; that fact that some of it, that it is not always all usable, does not to my mind mean that the process was not satisfactory. At times they lost control of it. I said the product at times was not workable at all, they sometimes got a product which they had to discard. I described it as a delicate process. That is correct. In the alleged A. F. A. Philadelphia installation, we had a rotary drum with the balls, the screen around the drum, the casing around that, and a conical discharge shell leading into a pipe that had a long angle portion to it. At the bottom of the pipe it discharged into a drum. (A drawing was shown to the witness.) This drawing, entitled "Plaintiffs' Diagrammatic Sections of Defendant's Alleged Prior Use", roughly illustrates it. As a difference, I may point out that there is far too great an amount of material in the outside screen. (The witness marked the

drawing.) I put an "A". There is far too much material shown at this point "A". Another defect is that there is always a cover at this point (indicating) with some holes in it. Q. Will you mark that B? (The witness marked the drawing.) And, of course, the relative proportions are not accurate. I can't tell you what they should be, I don't know that those angles are all right, these angles and all the rest of that. It is diagrammatic. The lower inclined section was a little longer, I suppose, than that. There is no scale on this drawing. Assuming a scale, it was longer than this, possibly twice as long.

(Drawing entitled "Plaintiffs' Diagrammatic Sections of Defendant's Alleged Prior Use" was marked Plantiffs' Exhibit number 43 for identification.)

There are many details, of course, left out of that drawing, and some of those details I think have an important bearing on the point. That shows a single casing apparently all made of one piece, welded up tight. There are no joints of any kind shown in that casing. Whereas the casing was made according to our blue print with many joints in it. (Exhibit D-15 was shown to the witness.) That is right. There was an opening for the air to escape in that installation that D-15 represents—not at the time it was originally installed. At the time it was installed there wasn't. There was very soon after that. I said there were many seams and cracks. They were slightly open. This note on our own Exhibit D-15, "All seams to be calked", means they were reasonably tight. Thin sheet metal of that kind, it was impossible to get them tight, and if you poured water, inverted that and poured water into it, water would have come running out through the cracks, in spite of the calking. I never did that.

It is a matter of my professional opinion as an engineer. On my direct examination, I said that some of the oxidation took place in this long, inclined pipe, in the space between the screen and the drum. I don't know whether any oxidation took place in this conical funnel shaped discharge portion. I don't know that it took place in the long, angular pipe that discharged to the drum. I can give it to you as my opinion; I never made any test there that would prove it. There is not any more reason why it should oxidize down here in the inclined portion than in this vertical portion. In making this inclined, instead of vertical, straight down to the drum, we copied the German installation. I only know that that is the way they put it up. I installed it, and as I understand it, you are not asking me for my opinions. If you are asking me for opinions and facts combined, some slight oxidation probably took place in the pipe. The inclination delayed the passage slightly.

Q. And permitted the air to act on it, if it was possible to oxidize it at that point?

A. It is my opinion, since that it what I understand you are asking, that some slight oxidation took place in the pipe. I have no idea how much. It couldn't have been much. The air comes in at holes in that cover, which I have indicated there, right near the letter "B". I have indicated the hole there in the cover.

Q. Where is the fan for forcing the air in there?

A. There is no fan.

Q. No fan of any kind?

A. No.

Q. Then what made the air go in?

A. The heat, the natural draft caused by the heat.

THE COURT: Is that identified?

MR. WHITCOMB: Yes. Plaintiffs' 43.

THE COURT: All right, so that it appears.

By MR. WHITCOMB:

Q. Then the air was supposed to go up and the material down, they were travelling in opposite directions?

A. It did do it, sir, it wasn't only supposed to, it was found to do so.

I never measured the air. Assuming the mill is just starting out, the heat is obtained by friction of the balls. Not in any other way until oxidation begins. Before oxidation begins, the heat in the ball drum would heat the air. That would cause the air to circulate. This top of this ball drum is all full of holes, the same as the bottom part. It would tend to start a circulation in and out of the drum, in some holes and out the others. Some of the bottom would be covered by balls, undoubtedly. That would stop up some of the holes to some extent, not entirely, however, because the balls themselves are porous, and the air would be able to come up through the holes and through the balls. The balls do not entirely prevent the air from circulating through the mass of balls. The air would go out the top and in the bottom, there would be a circulation of air through the drum. The air would presumably be going up through, sucked into the drum at that point (indicated by counsel). When you ask whether it would have a downward component at that point, some halfway down from the middle, you are asking very speculative questions. I don't know whether it would or not; I should not expect it to have a downward tendency. It might, the whole interior of the casing when the mill is revolving, the air is stirred up there pretty generally, and exactly what direction the different currents take I am not able to tell you. I don't remember how much

percentage of oxygen there is in air. It is in all the textbooks. I think it is about sixteen per cent. The rest is chiefly nitrogen. Some eighty per cent might be nitrogen and some sixteen to twenty per cent oxygen. That is approximate. And there are other inert gases. There was no drawing ever made of the small pipe, as it was called in my original notes; or stack. I haven't any drawing. I don't know the date when it was made. I think there is a later drawing showing it, but there was no drawing made at the time it was put in. I think the later drawing can be produced. I think it will be produced in Mr. Reinhardt's testimony. We have no drawing, if I may clarify that question. I have no drawing that shows that pipe installed on the Philadelphia mill, if that will clear your question. I did not mean that there was a drawing for the alleged replica made in Toronto.

I don't know whether I have a record of the yield produced in pounds of powder per hour from the alleged A. F. A. Philadelphia installation. (The witness examined his notes.) I don't know without looking at the sheets. I know I have such a record. I have a general recollection it was somewhere in the neighborhood of a hundred pounds an hour, but I am not sure that that is accurate at all. It wasn't much less.

Defendant's Exhibit number 18, is Kershaw's test, dated 8 20 to 8 26, 8 20—26 16. The yield per hour was about forty pounds. On the next sheet, the maximum was about the same—well, a little higher, something like forty-five. Each of these sheets represents a week. On Exhibit D-18, we have at times only thirty-five and just past forty pounds per hour. That is right. The next sheet is about fifty-five and the next one about fifty-five. That is the last of these sheets. I don't remember what was the yield in the Toronto replica. I haven't got the notes before me. I wasn't

there the second day, the second time it was run. At the time when the plaintiffs' experts were there, I was not there. I do not have before me the data on the other mills for the same period as this Exhibit D-18. It is probably here in the room somewhere. There was one mill at Philadelphia of this kind. I can tell you how much lead powder was produced during the time that the mill was running. This first sheet does not cover a week. The mill wasn't running for a week. I said the sheet covers a week, but the mill wasn't running all the week. If you multiply the forty, it is about forty pounds per hour, if you multiply that by the number of hours run, that would give you the production during that particular week. I don't know how many pounds. (The witness made a calculation.) As I see that the mill was in operation about four and a half days during that week, twenty-four hours a day, a hundred and eight hours, I believe that is, and it was doing about forty pounds an hour; made some four thousand pounds during that time. I can't give you any idea of the total amount of oxides required by Exide during that week, in their normal business production. I haven't any idea of the order of that at this time. If it will help you, it was much more than this, of course. I don't know how much more. I haven't any estimate at all. I can't remember that without figuring back pretty carefully. That has been a good many years ago. Conditions have changed very much. It was back in 1916. I can't give you any guess on that figure. Naturally, that mill did not supply all the requirements of Exide during that week. We had to purchase a lot, unquestionably. We were certainly not using anything approaching four million pounds a week. I haven't any idea of what we used in a week at that time. I don't know how much it was and I'm afraid you can't find it out, can't find out from me something that I don't know.

MR. WHITCOMB: Of course, if Your Honor please, he got records of all kinds when he wanted to testify on direct, you see.

THE WITNESS: Undoubtedly—

MR. WHITCOMB: I think they are put under a rather unusual position.

THE COURT: Well, how do you mean?

MR. WHITCOMB: Well, I mean, you see, when we ask him something specific we can't get it.

THE COURT: Well, surely, you can draw any argument you want from the fact that he won't give you any estimate—

MR. WHITCOMB: Yes.

THE COURT: —on that.

MR. WHITCOMB: Yes.

THE COURT: It is a proper matter to argue.

I do not know accurately about the present time requirements. It would take a good many mills of that kind, producing forty to fifty, or even the maximum, fifty-five pounds an hour, to supply Exide's normal requirements in any one week you want to pick in 1935. It certainly wouldn't take a thousand. (The witness calculated.) You asked me how many mills it would take to supply present needs of this kind. (The witness made a calculation.) I would say not more than a hundred, probably less. It would probably take less than that, I would feel. My guess is that it would take less than a hundred mills, and probably a good deal less. I can't give you anything accurate on that. I haven't got the accurate figures in my head and I can't quote you accurately.

On rare occasions, we do let people in to see these

mills in the plant now. That has been the practice of our company for some time. There was no payment made for this particular information obtained from the A. F. A. I can explain that to your Honor if you care to know. We have an arrangement with the German company by which they have access to our plant and we have access to theirs, plant and manufacturing details. I doubt if they would let you in the plant in Philadelphia. Well, I don't know, maybe after all this we would.

The plates that were alleged to have been sold to the New York Railways Company were the size that is known as our MV, 8 5/8 by 5 3/4 by 3/16 thick. They were storage battery plates, larger than automobile storage battery, about twice as big. The size of automobile batteries varies a whole lot. As to the one that is in evidence, you can tell by taking a rule. These were about the same width, 8 5/8 high, which isn't quite twice as high as that. But the plate of course was thicker, about twice as thick, so that all together the plate, I would say, weighed about three times as much as one of those. (The witness referred to Plaintiffs' Exhibit 33). I believe the order was for seventy sets. (The witness referred to the order.) It is in the exhibit, I think it is seventy. This order calls for seventy sets. The storage battery company furnishes on order whatever it chooses; there were no specifications as to what it furnished, covering the material and the detail of manufacture. I don't know whether the New York Railways Company knew we were making these plates from this material or not. I expect they did. I don't know that they did. I believe this material was used in the positive plates only. The number of cells per set that I have given in my notes I think was fifty-eight—yes, fifty-eight cells. As to how many plates were called for in that order of seventy sets, that is in

my notes that you have. I made that calculation. I did not make it for the seventy sets. 56,840 positive plates would be required for that total quota of seventy sets. Of negative plates there were a little more than that same number, 15/14 of that, 1/14 more than that, whatever that comes to. There were something like 105,000 plates, of which 16,000 were made of this lead dust. The production of these plates was authorized in the regular manufacturing department. A number of other departments had something to do with their authorization, as they had with all standard plates. All plates are manufactured according to instructions from the D. and D. Department. That is the Department of Development and Design. All plates are made under their direction. All plates are made according to their specifications. We have day by day control of production of regular plates by inspectors through the factory, following the manufacture. The inspectors come under my department for regular production work. I have no figures as to the relative time of formation of the plates for the New York Railway made by the lead dust, as compared with the time of formation of other plates. As far as I know, it was about the same. I don't know whether it was longer or shorter. I cannot find out from any information I have. The information can be obtained but I haven't got it here. I cannot supply it before I finish my cross-examination. It can be gotten before the case ends. The amount of current required in the formation of these plates, as compared with other plates was substantially the same. I can't swear it wasn't more or it wasn't less but I can swear it was substantially the same. I haven't any figures on it. I will get the figures for that. Let me get that down exactly, length of time and the current. Do you want those figures compared with the standard, corresponding to the amount of corresponding materials and standard—

Referring to Defendant's Exhibit 29, I think it is correct that the batteries supplied to the New York Railways, were not referred to as "test batteries". I don't find it in here yet. Perhaps it is here. Looking at the first line of the third paragraph, it states special positives and negatives. That is correct. I don't know whether I have the data as to when we started delivery of the first lot of seventy batteries for the New York Railways. As far as I know, these are the only ones that were sold during this period of 1916, to 1918, made by this A. F. A. installation. It can no doubt be found when those were first shipped from the factory. I have the back of Exhibit 27. I don't know whether it is exactly the question Mr. Whitcomb wants, I am not sure. It tells when the varieties of that battery were shipped. Whether we can identify these particular ones, I am not sure. This record which I have before me shows that all—I think it is all seventy batteries had been shipped by May 17, 1917. The delivery began in November, 1916, but it doesn't show, as far as I see now, just when these particular lead dust batteries were shipped. It couldn't have been prior to the end of 1916, November. In Exhibit 21, which I introduced, there is an order to "Stop making lead dust plates", issued February 17, 1917. That is correct. I never operated the lead dust mill myself. These New York batteries were the only ones that were sold, as far as I know. That is, represented the only commercial production of that mill. There were twenty-five sets of test batteries all together. That is, twenty-five batteries. There were 16,000 positives in the first set and 3,000 in the other, I think. I will have to look at my notes. They were good sized batteries, each cell having twenty-nine plates, and there were fifty-eight cells in the battery, for operating street-cars. The Department of Design very frequently gave in-

structions similar to our Exhibit 29 in the customary practice. In use, you have a lot of plates that go through, of course. But we have some specially made like these. In this particular instance, these particular batteries were made under a special classification. In fact, on the first line of the second paragraph of the exhibit, they refer to them as special positives and negatives.

As to when the A. F. A. mill at Philadelphia was dismantled, I can only give the dates at which instructions were given for dismantling. I don't know exactly when these instructions were followed out. That was in the summer of 1919. I think it was followed out reasonably promptly. For instance, I find a letter of August 14, "Please be advised that Mr. Speed has completed the dismantling of the lead powder mill. . . ." That was August 14, 1919. There is nothing in our records that shows the basis upon which the payment was made from Willard for the dismantled mill. I think it is referred to here somewhere. Looking at the exhibit, I see "This price has been determined upon quotations made to us on the current cost of replacing this equipment." This doesn't indicate anything particularly to me as to the relations between the Willard Company and the defendant at that time. Our company controls the Willard Company now. They did then. In the meantime, in 1917 and 1918 and 1919 the company was purchasing the bulk of the oxides used by the plant.

I referred to this large drawing, SE 2300, Exhibit number 39. It was dated October 1920. We never made the mill, that's right. There was no note on this drawing that I see there which refers to the holes in the mill. The mill was never made. They were proposed. We abandoned it before we ever made the mill. This drawing doesn't show anything about the

air inlet, of course. There were to be holes in the mill, in the shell. There were no means of introducing air other than the holes. This is a replica of the German mill, except longer, as I described in my notes. The diameter, I believe, was to have been the same, but the length was longer. There is no casing shown here at all. This does show the casing, I believe. There is no stack shown on this drawing. In the right-hand figure, there is a continuation to the discharge affair. The casing is shown. Then that discharges into that close screw conveyor. Moves the material, if any made, supposedly over to the discharge affair. Now, it is shown in this drawing, an opening in the casing, at the point 8. I don't know whether that is a manhole or not. The material is to be introduced in this mill through one of the hollow trunnions. There is no chute shown for introducing—this is not a one batch process. I know that because I helped to design it. I worked on it, and it was designed under my direction. I can't tell without looking at the detailed drawing whether number 8 is a manhole as you suggest, or whether it is a vent pipe. There is nothing on the drawing which says. The mill was never constructed.

My next reference, in order of time, is to the Hall activity in 1920 and 1921. We had never constructed any Hardinge mill or used it for that purpose, when that was started. At that time the Hardinge mill was one that would be very successful with the grinding operations, and it was thought by Hall that it was adaptable and eminently suitable for that process.

Q. Did you in your process utilize the grinding process rather than the tumbling of the balls process?

A. No, that is hardly a fair statement. We did use a grinding method in both mills, cylindrical mills, we used the grinding before the oxidation of the surface of the balls.

I don't know whether the Hardinge mill had been used with the forced draft at that time or not. I don't know whether or not the ordinary Hardinge mill had any means for introducing air, blowing air into the drum, at that time. In any case, the Hardinge mills were using the wet grinding, but I think not always. The means were always there. They had trunnion openings at both ends. Just how often they used air in there, I don't know. I have seen some of Hardinge's patents. I don't know whether I have seen that one or not. (The witness examined the paper, Hardinge patent 1,450,289). I don't know whether I have ever seen that one or not. I know Hardinge has used air currents. That is the Hardinge patent. I will read the paragraph beginning at line 34 or '5. "One of the principal objects of the present invention is to provide a method of and apparatus for aiding the above described inherent classifying action of conical mills. Stated somewhat generically, the invention comprises employing the conical outlet or a portion thereof as a conduit through which a current of elastic fluid is directed toward the outlet opening from the inside of the drum." Hall proposed to allow for circulation of air through the holes, trunnions. He did not at first believe that the fan was necessary. He felt that he did not get enough circulation from those natural causes, and then supplied a fan to it. We use a fan now. We don't run the Hardinge mill now without a fan, certainly not preferably. We think we would get the production we need if we used the chimney, but you need to get a current of air through there to get the oxidation. We use a fan. It is true that it requires more air than will naturally circulate. This particular patent states: "It is important, for various reasons, that the material be removed from the drum with the utmost dispatch as soon as it is reduced

to the desired degree of fineness." That is not important in Hall's process. "Some of the more important of these reasons may be stated as follows:" and so on. "any fines within the mill are so much dead weight and increase the power required to rotate the mill." That is true of the Hardinge mill, if they were not removed, but if I may enlarge on that for a moment, the air is not at all necessary for removing fines in Hall's process. I don't know whether it was necessary in this Hardinge patent or not. I had nothing to do with this patent. I am not responsible for what Hardinge did. He found in certain of his work it was desirable to blow the air out. We found in ours it was not necessary. We collect a little of the material with the cyclone collector or bag collector now. About one-twelfth of this material we get from the cyclone and bag. I have no doubt, as Dr. Wilson's report states, that we used the monogram number three fan. It looks to be a correct catalog for that fan.

(Counsel for plaintiffs thereupon offered in evidence a catalog headed "Sturtevant Monogram Fans" marked "Bulletin Number 337", which was received in evidence and marked Plaintiffs' Exhibit number 44.)

I do not see any mention of three oughts, I see one and two oughts, I don't see any three oughts. That is a much larger fan. These are the smaller ones down here, (indicating), if I am not mistaken. I understood you to say three ought fan. I haven't any idea of the size fan we use now. The fan shown in here is number 3 Monogram Fan. I don't know what the rotation of the fan is. If Dr. Wilson states in his report that it was about twenty-six hundred, I will have to take Dr. Wilson's figures for that. The maximum number of cubic feet per minute that the number

theree Monogram Fan operated in the neighborhood of twenty-six hundred r. p. m. will cause is given in this table as two thousand. The minimum is zero. At twenty-six hundred r. p. m. the maximum is 1580—1780. At twenty-six thirty r. p. m., the maximum volume which appears to be given in this table is 1780. The minimum of course is zero. I thought you asked me what was the minimum that they found it would supply. Well, the amount of air the fan will pass depends entirely on the conditions under which it was working. Under the conditions illustrated on that sheet under the calculation of the number three Monogram fan, there was no minimum given. 1780 is given there as the volume which it will pass at a static pressure of six inches but under a static pressure of nine inches in the column below the horizontal line, it gives less, twelve hundred. I am reading r. p. m., 2630 static pressure of nine inches. For the 2630 there is given one thousand. For the static pressure of one inch it gives 2540.

According to my testimony, Mr. Hall or somebody at the plant ordered a new blower on May 5, 1921, 1920. I have the exhibit that shows the order for that blower. It shows "One three ought type P blower with a direct connected 110 volt D. C. motor complete without motor control. Speed 3400 r. p. m." I don't know what the capacity in cubic feet a minute of that fan was, unless it is stated here somewhere. I think it says, "With the system reduced for connection to gas meter, as you suggested, this outfit should easily deliver two thousand cubic feet per hour."

Referring to my duplicate notes which have been marked Exhibit P-42 for identification, page twenty, I did not list the air twice when I was talking about the early Hardinge mill. I made a separate heading for air. I enlarged on each of these three things, or,

at least the first two of them, by separate paragraphs. The heading for air was not underlined as the others were. Then Mr. Hall ordered this fan capable of producing two thousand cubic feet per hour. We used other fans later on. I don't know whether that particular fan was changed on that mill or not. This first Hardinge mill was the same size as the others. I forget whether it was twenty-two inches by six feet. It is on the record here, five feet by twenty-two inches. It is just the same as the others that are now in use. I haven't got a copy of Dr. Wilson's report, so that I can't check that up. They are all the same size.

Referring to the first temperature charts that we introduced at the first Hardinge mill, Exhibit 49, that shows under date of March 2, starting up from a cold mill, the temperature finally reached a maximum of slightly above 175—177, and on the next day, March 3, it shows a temperature going as high as a little above 190, at the maximum.

You refer to Dr. Wilson's report, Exhibit 20, in which he gives a dimension of the mills as six by nine feet. I still stick to my last few answers about the size of the mill. I would like to refer to some of the other sheets which I think will confirm it, and I think the apparent discrepancy is due to the fact that Dr. Wilson measures the length of the mill over all, and, supposedly, the diameter, whereas the Hardinge Company estimates it by the length of the conical part and the diameter of the conical part, the diameter of the flat part. The cylindrical part in these notes is twenty-two inches long, the total length of the mill from end to end is, no doubt, as Dr. Wilson states it. The diameter there appears to be a slight diversion between the two. I wouldn't care to give the length of the drum of the first Hardinge mill, I don't know. Of course, the length of the cylindrical part of the drum

shows twenty-two inches. I don't know the length of the whole drum, including the two cones and the cylinder, but this is according to Dr. Wilson's figures. This cylindrical part is twenty-two inches long, and that is the way the Hardinge Company rates the mill, the length and diameter of that part (indicating). The original mill, to the best of my recollection, is exactly the same as all of the later ones in the main dimensions. That can be verified, if you so desire. I think they are identical. I happen to be wrong about that. I find on one of these later requisitions, the newer mills were six by twenty-two inches. I still don't think it is right. It appears from these records that the first mill was five feet in diameter, later ones six. I still think they were all the same, but I may be wrong. The total over all length of the drum itself was approximately the same in all, twenty-two inches.

Coming back to the question of temperature control, they do not heat the air before they blow it in. Dr. Wilson's report that the heat of the contents of the mill is produced exclusively by chemical reaction and friction is correct.

Q. What is the control—

A. There is excessive heat generated in the mill, and some of this heat has to be taken away by the water which is put on the outside of the mill. The rubbing and the chemical action together takes it up to three hundred Centigrade. We just put the dry balls in the mill and revolving them generates that much heat. It will melt the contents completely, if you don't cool it. It generates more heat than you need. You have to cool it, at a very slow rotation. The air given is at room temperature. Inside the drum it may be upwards of three hundred. You have the cooling effect of the cool air coming in as well, just as the air you blow in the fire may cool the fire. It would not

have that effect if you blew it in all the time. It would probably heat it more by chemical action. If you blow air in a fire it will cool the walls of the furnace. The material itself is what we are interested in, the melted lead balls. It won't cool that, but it will cool the structure you have the fire in. It will also contact the material, subject the material to a difference of temperature of 100 degrees when it first contacts the material in the drum.

Q. We are talking about the control. Will you refer to Defendant's Exhibit 66 and state when that was obtained and how would you characterize the regularity of the temperature and the control of the temperature during the run illustrated in that chart?

A. Chart 66, Defendant's Exhibit 66, bears date ninth month twenty-eighth, 1921, shows during that interval between then and the early part of 1921 the control of temperature had been very much perfected. That more or less smooth curve around there indicates that we were able to hold the temperature accurately. The curve in Defendant's Exhibit 49 as compared with the character of the curve shown in Exhibit 66 shows in the first place a lower temperature in 49 and in the second place that the control of the temperature was not so accurate. The date of the run of Exhibit 49 was March 2 or 3, 1921. These two exhibits show that between March, 1921, and September, 1921, with respect to the operation of the mills, insofar as uniformity of the temperature is concerned, that Hall had acquired the necessary skill to operate his mill. It didn't take quite that long. He had it going pretty smoothly before that. I don't know if I have any record that shows it exactly. By June he had it going pretty smooth. He did not get a curve for June, but I have records—if you will turn to Defendant's Exhibit 62—the one I have doesn't show the vari-

ation from 190 to 150. I am looking at 61. It is Exhibit 60. Excuse me. I referred to June. It is Exhibit 60. In June he had obtained a more regular control and was getting a more uniform temperature. Referring to the exhibits with respect to the Hardinge mills in 1921 or 1920, on the subject of the load, you want the first reference to the load, the earliest reference, the earliest reference that I have to the load. The one that shows the smallest amounts of load in the Hardinge mill. Exhibit 51, March, 1921, shows, according to my interpretation, that the mill was started with 7882 pounds of balls. They continued to add balls, and the first note of any discharge from the mill is twelve o'clock, after which they added one, two, three, four, five, six—they had added a lot in weight by that time. Apparently, they had added fifty-eight hundred, before there is any note of anything coming out of the mill. As shown by our exhibit 61, the loading that took place in September, 1921, is marked nineteen thousand pounds, in sheet number one—9-26. I don't know that the maximum in March was about twelve thousand. I doubt if the maximum is given. I find that the bottom of the second one of those sheets, the third month, sixteenth, an addition of two figures which comes to 15,382. I take it that is the amount of charge that was in the mill, and I see no notes on either of those pages as to what output they got, other than that they were discharging lumps ring-formed. The mill was not running satisfactorily on that day, certainly, because it says they shut down, placed washers under the bolts to stop the leak. I can't explain definitely a reading on Exhibit 60 of .05 and .06, and I note that, at the bottom, about nine cubic feet, whereas on Exhibit 61 the readings on the first page indicate .95 for the air, other than to say in those readings there seems to have been some confusion on the

second sheet. I mean the first sheet, I mean the sheet dated ninth month, twenty-sixth, 1921. That is defendant's Exhibit 61. And at the top it is marked Sheet No. 1, and in white, 39. There appears to have been confusion in taking down these air readings, because some of them are .05 and some of them are .5. I can give no other explanation. They may have changed the pressure, changed the flow of air, or there may have been discrepancy in putting down readings. One reading .5 would not be ten times more than .05. The velocity of air is not proportionate directly to the pressure. The ratio is square root I think. It would be much less different, and if you will notice the further pages, they all refer to .05, so that I think that there is some confusion there as to that amount of air. Referring to Defendant's Exhibit 61, the last page, dated ninth month, twenty-seventh, 1921, he was getting 370 pounds an hour between six and seven P. M., before the air was shut off. At six o'clock 350 pounds were taken off and an hour later, seven o'clock, 400 pounds. The air was shut off at seven. The next time reading is seven. It looks like another 100 pounds was taken off at seven. It couldn't be seven-ten.

THE COURT: What is the date of these operations he is talking about now?

MR. WHITCOMB: 1921.

THE COURT: That is the Hardinge mill?

MR. WHITCOMB: Yes.

THE COURT: Yes.

MR. WHITCOMB: This shows the difficulties encountered and what happened, and this is an interesting one to show what happened when the air was shut off.

The witness, resuming, testified: At eight o'clock,

after running an hour, only thirty pounds were taken off. That looks right. Shutting off the air and the fact that they added no more balls after seven o'clock, very few more balls after seven o'clock, had a decided effect on the operation. They fed some balls at seven. At six they fed 350 pounds. Then for that charge of 350 at six, with the air on, they drew off 400 pounds at seven. That is right. And at seven o'clock they fed another 400 pounds of raw material and yet drew off 100 pounds at some time, looks to me like seven. Well, at seven that would certainly have come from the previous feed, and then until eight o'clock the only product produced dropped right down to thirty pounds. That appears to be correct.

The specific gravity listed on this exhibit I have in my hand, Defendant's Exhibit 61, is not the true specific gravity, it is the apparent specific gravity. That means the specific gravity of the loose material, not packed. The specific gravity of lead itself would be 11.34, if I remember. It is relatively heavy. And this is two. It is obtained in several ways. One is to take a small, known volume crucible and let the stuff drop into that and then skim off the top. You let it pour in at no particular rate, just pour it in by hand. A somewhat refined method is that known as the Scott volumeter, where the lead is also poured down on to a small vessel of known volume, and then it is cut off straight at the top and weighed. There is no mechanical shaking in that. It is just poured by hand. It goes down a series of steps, so as to get thoroughly distributed, and broken up, in dropping down. The steps are about an inch apart, I think. Pretty close. The fall is something like this (indicating) zig zag. I don't know how many steps you have. It is a perfectly well-known instrument, you can easily verify exactly what it is. That is not the only method we employ. I don't

know which of these this exhibit refers to. Both methods are reasonably close in results. I think this one refers to the first method, because when it is expressed in the Scott volumeter it is not expressd in the same terms, and I think, therefore, that this one was made by pouring it into the crucible. I believe that was entirely done by hand. You have no gauge at all, it is like filling a teaspoon to overflowing and then scraping off the excess.

Referring to Defendant's Exhibit 54, we started at eight A. M. and shut down at 10:50 for repairs. Started at 1:05 P. M. Before that the disc at the discharge end caught in the screen. I am not quite clear as to what the disc is to which it refers. The screen is perfectly plain, the screen is the rotating screen sifter which is attached to the end of the mill, and this screen—this disc which I am not clear about, caught in the screen, probably tore a hole in the sieve. Then in the afternoon, the motor was out of order, screw conveyor motor was out of order. That test was in April, 1921. Turning to the test of April 15, 1921, which is shown on Defendant's Exhibit 57, they were running into troubles with the ring forming inside the mill. It is formed from the product, the oxide. It clogs the mill and prevents it from discharging, and stops its operation, very much impedes its operation. Defendant's Exhibit 57 also speaks of the dust burning. There are several instances of the formation of the ring in Exhibit 57. I see only the one of the dust burning. About the reference to the dust burning, I have only got to the first page there.

In my notes marked for identification Plaintiffs' Exhibit 42, page 11, I refer to this as an experimental manufacture. I don't know whether I am there referring to the installation of the first 1916 mill or not. The word "experimental" is used there. It is under-

scored in pencil. That is correct. Then, again, on page 16, for a second lot of plates in the order for the New York Railways, I think I refer to it that it was decided to make a further "demonstration of the lead dust positives". Then, again, on page 13, I refer to these first cells as being put on test on August 16, 1916. That is correct. That is a laboratory test. They are the laboratory tests I referred to in my direct testimony. I don't know whether I have stated definitely in what year and what month Hall had his type of apparatus working to the satisfaction of the company at the earliest time. In the notes, I implied that by the middle of 1921 he had got most of his mechanical difficulties straightened out, and from that time on was able to produce material satisfactorily.

Q. Well, you speak of mechanical difficulties, they are all these difficulties you have been testifying about in comparing the different charts in April and August and September, are they not?

A. Yes—what is that?

Mr. Whitcomb: Read the question.

(The question was repeated by the Reporter, as follows:

"Q. Well, you speak of mechanical difficulties, they are all these difficulties you have been testifying about in comparing the different charts in April and August and September, are they not?")

By Mr. Whitcomb:

Q. That is air, temperature control—

A. Wait a moment, now, the difficulties we were speaking about were the formation of rings and the mill burning. That was in April.

Q. But this morning you also testified about the

lack of uniformity of the temperature charts for the early days, did you not, as compared to those —

A. As compared to the later ones, yes.

Q. And the same with respect to the feed and amount of material and product produced?

A. I don't remember testifying anything about that this morning.

Q. This afternoon, I mean.

A. I would like to get a little clearer your question. It isn't quite clear to me what you are getting at.

Q. Well, as I understood it, for example, in many of these sheets you produced, say, in March and April we have questioned about these difficulties they show?

A. That is correct.

Q. Whereas the latter tests, around September, and so on, show a much more satisfactory operation, is that—

A. That is correct.

Q. Is that correct?

A. Yes, that is correct.

Re-direct-examination.

By Mr. Morris:

I agree with Mr. Ishimura and Dr. Clark that no product in the way of powder will be obtained from rumbling lead balls in a rotating mill in an inert atmosphere. That is, if you have no oxygen present, you get no product. We got a product with the mill installed in Philadelphia at 19th and Allegheny Avenue. It becomes obvious from that fact that air was entering into the interior of the drum. From the fact that we continued to get a product, it is perfectly obvious that air must have continued to get into the drum.

THE COURT: Are you speaking of what we have called the A. F. A. mill?

MR. MORRIS: A. F. A. mill, 1916 and 1918.

19th and Allegheny Avenue is the location of the office. That is it. And Crescentville is the location of our present plant. The first Hardinge mill was installed at 19th Street, the same place as the original German mill, not the building, but the factory, the same general location. We certainly got a product from the 1916-'18 perforated drum installation. The product was a porous mass of particles. It was reactive. Much of it was spontaneously converted into litharge by merely exposing it to air. That also started if a drop of water was put on it. If a lighted match was applied to it, that started burning. The oxidation continued until it had gone all the way through. In some of that product of the 1916-1918 mill, of the lower oxidation, all of those properties were present. In the higher oxidations the reactivity with oxygen was very much less, so that some of it of the higher oxidation would not burn when you put a match to it.

In my testimony I specified that we had put as many as eight mills in the Crescentville plant, but I didn't limit it to that. There were two more after those that I mentioned, to make ten altogether, including the old mill, the old, original mill, which has since been moved up there. I spoke of the defendant controlling the Willard Company. That is by stock ownership. In my cross-examination I said that more air was needed than is obtained by natural circulation. That was applied to the Hardinge mill. That is right.

The effective capacity of a fan is affected by the conditions by which it is surrounded. A fan

will maintain a certain—at a certain number of revolutions will give you a certain maximum pressure. The pressure produces a flow of air through the delivery system. The amount of air so delivered depends equally upon the pressure supplied by the blower and upon the resistance of the system into which it is blowing the air. For instance, if it is blowing through—if the fan as big as this easel here were blowing into a pipe as big as my finger it would deliver an extremely small amount of air, even though the fan had a high rating, and a fan is not what is called a positive blower, its delivery depends entirely on the resistance to which it is delivering this air. Any fan, no matter how big, if the air pipe is shut off will stop delivering. Notwithstanding it continues to rotate.

On cross-examination I was asked a few questions with regard to the quantity of air passing through our mill under given conditions. I have read the patent 150.

Q. And I call your attention to the only places that I can find with regard to air in that patent. The first one is line 11, 10 and 11. I call attention to line 11, 10 and 11, which say introducing into the vessel while slowly rotating air or any gas containing oxygen. Do you find in that statement any rate of introducing the air?

Mr. Whitcomb: If your Honor please, of course, this witness was not asked anything about the patents on direct.

The Court: No. He wasn't, and isn't it all a matter of argument, anyhow?

Mr. Morris: I think so, I can make my point by a statement of mine at this time, rather than

further examining the witness, and that is that I find nothing in any of the patents which shows what the relationship between air or these other ingredients is.

THE COURT: Well, that will be a matter—

MR. MORRIS: Yes, I thought your Honor should have that in mind.

THE COURT: All right, any time.

MR. MORRIS: That is all.

MR. WHITCOMB: Well, of course, your Honor,—

MR. MORRIS: Oh, just one—pardon me.

MR. WHITCOMB: What I was going to say, of course, we have presented the testimony of our Dr. Clark and others as showing what that same patent discloses with respect to air.

THE COURT: Yes.

MR. MORRIS: Well, that is all I want to call attention to, my point is there, good or bad.

The witness resuming, testified:

I testified that the old mill in the 1916-18 installation in Philadelphia was shipped to the Willard Storage Battery Company, at Cleveland. It was shipped back to the Electric Storage Battery by the Willard Company. Then it went into a storeroom which we have for putting in a machine that is no longer used. It stayed in that storeroom for an unknown length of time and was eventually sold as scrap iron. As to the approximate date, I only know that when we went to look for it some years later it was missing, I don't know exactly when, somewhere about the neighborhood

of '23, '4 or '5. That was after the Hall installation.

By THE COURT:

Q. Now, let me ask one question. When you were testifying before the Examiner in Interferences, or by deposition, your testimony as I read it amounts to a pretty assured statement that the product contained lead suboxide, I can't make much else out of it, but that is the net result of your testimony. I am not trying to pick up a word here and there, but the whole thing contains to my mind a very definitely assured statement that that product contained lead suboxide, if I were listening to it, I would get that impression. Now, is your position now that you did not intend to convey that, or that you did intend to convey it but that you are satisfied it was a mistake and you have a different view now? I just wanted to get your interpretation of your testimony at the Interference. It is one of those two things?

A. Yes.

Q. I don't see how anybody can read that testimony, without getting the idea that you were testifying that there was lead suboxide in that product and that it could be controlled and that you could get as much or as little as you wanted.

A. My interpretation of that is this, that I specified that there was suboxide in there as defined in the terms which we had been talking about, and on page 370, to which Judge Morris referred, I think that is made quite clear, sir.

Q. Well, it isn't quite clear to me, I will be frank about it.

MR. MORRIS: May I ask one or two questions about that? I intended to, and forgot it.

THE COURT: Yes, in a minute.

By THE COURT:

Q. There either is or is not lead suboxide?

A. Well,—

Q. It either exists or it does not exist, and when you say it does not exist but it does exist as you define it, it doesn't carry much of an idea to my mind.

A. Well, I think I can clear that up to you, sir.

Q. I thought that your testimony as I read it was that suboxide did exist, and I couldn't—

A. The question as to—

Q. Now, you may have been—excuse me—you may have been mistaken at that time, or you may not have meant to say that, I don't know which it is, because you are saying something quite different now.

A. Well, may I explain?

Q. All right, now, you go ahead, I will stop.

A. The question as to the existence or otherwise of true chemical suboxide, Pb_2O, had long been a matter of doubt, nobody knew whether there really was such a thing or not. It was, however, listed in the textbooks of that time. We were all doubtful as to whether the real, true suboxide, Pb_2O existed, we didn't know. We did know, however, that we had, we could produce in these mills this black pyrophoric material which corresponded to the descriptions of suboxide. That was the sense in which I said I knew it existed. I knew we could make this black pyrophoric powder, and I still am perfectly convinced of that, we can make it today any time we want to.

Since that time new experiments, new work has been done on it, which has very much clarified the question as to whether the true chemical suboxide, Pb_2O, actually does exist. My opinion, therefore, is very strong as of today that the existence of the true lead suboxide has never been proved.

THE COURT: All right.

MR. MORRIS: May I ask just one or two questions?

THE COURT: Surely.

By MR. MORRIS:

Q. The Interference in that case, if I recall, involved patent 150 of Shimadzu. Shimadzu, as I understand it, described or catalogued, so to speak, certain characteristics—

A. Yes.

Q. —of the product in his patent. He assigned—am I right?

A. Yes.

Q. He assigned to that the name of suboxide?

A. Yes.

Q. Now, then, is your last statement, does your last statement mean that if Shimadzu's product, of which he defined the physical properties, was suboxide, that you had made that material, or not?

MR. WHITCOMB: Objected to as clearly leading.

THE COURT: Well, it is, but it is all right.

A. That is what I intended to signify.

By MR. MORRIS:

Q. Because that was the issue, as to whether that product—

A. That was the issue.

Q. —had been made, regardless of what it was called?

A. That was the issue.

MR. MORRIS: That is all.

Re-cross-examination.

By Mr. Whitcomb:

Q. Just a moment, Mr. Smith, it seems to me, now, you have referred to opinions, upon what authorities do you base your opinion now, and what did you during the Interference, what publications or authorities or books?

A. Well, there are plenty of books, chemistry books, up to a very recent time, which refer to suboxide of lead.

Q. Those that we have been hearing here in the testimony of Dr. Clark and others?

A. No, chemistry books in general.

Q. Do you include any of those he referred to?

A. I don't believe I did, because I think they were much later books.

Q. You didn't refer to Tanatar?

A. No, I referred to the common, ordinary, every-day chemistry books that you buy in this country.

Q. I mean, your answer now, you have expressed an opinion on information obtained in recent years?

A. Yes.

Q. Yes.

A. I said there had been a lot of work done, which had very much clarified the question.

By the Court:

Q. Well, but I still feel in line with all that, and assuming that you were talking in the terms of this patent, for instance, on line 38, where it says a coating of lead suboxide which being brittle and lacking tenacity compared with metallic lead, you still gave me the impression of talking about something different from ordinary lead oxide.

A. It was different from ordinary—

Q. Or lead monoxide.

A. It was different from lead monoxide, surely.

Q. Well, then, you get to a point where you have got to give it a name, and if it was different from lead monoxide, and it wasn't litharge, and wasn't red lead, and wasn't the other oxides, you must give it a name. Now, if we call it lead suboxide, all right, or if we call it lead half oxide, or anything else, but it still is a different chemical substance, and it seems to me you were talking about a different chemical substance from litharge and the various other well-known oxides of lead.

A. We didn't—we had no means of telling at that time exactly what was the chemical constitution of this material.

Q. Well, I say, but you talked about a—

A. I did.

Q. —different product, which you provisionally called lead suboxide?

A. Yes.

Q. Now, then, Dr. Clark comes along and he says, "There is a different product, and I call it lead suboxide":

A. Yes.

Q. So how do you and Dr. Clark really essentially differ?

A. We differ in opinions, I guess, only.

Q. Well, I don't see how you differ so much in opinions.

A. I agree—

Q. If you were talking, if this was a thing which was brittle, and lacking tenacity, and easily reduced to powder by aorasion, and was reactive, and all that, if that was something different from the known lead oxides, from the common lead oxides, then the question of what you call it is a matter of terminology, entirely?

A. Yes.

Q. And then Dr. Clark and you are very close together, it seems to me.

A. I think we are close together in that we both agree that suboxide, the existence of suboxide has never been definitely proved.

Q. Well, he thinks he proved it pretty definitely.

A. I misunderstood him if that is the case.

Q. Well, I misunderstood him if he didn't, if he didn't think he proved it.

MR. MORRIS: May I ask just one—

THE COURT: I am not passing an opinion on whether he did or not.

It might be I can make that a little clearer to your HONOR. This black oxide that we all got in those earlier stages was not any of the ordinary oxides, you couldn't go into the market and buy a ton of that stuff, buy it by the ton, it wasn't to be had, it wasn't the ordinary oxide. It was, however, as—it was probably a mixture of something, and its composition, its chemical composition, the amount of oxygen more or less corresponded to suboxide, and it was by the early chemists supposed to be a true suboxide. It was different from red lead, or litharge, or the ordinary oxides of lead, and there was no question about it being a black oxide of lead.

Lead monoxide is not readily reactive to oxygen at all. Lead monoxide itself does not burn in the air. Powdered lead, under certain conditions, will burn in the air. Exceedingly fine powdered lead, especially if it is a little flakey, can be made to burn in the air, will burn in the air. I think it will ignite spontaneously at times. The product that I was speaking of in Washington or in the Interference

was not pure monoxide. We didn't definitely know at that time how the product was divided chemically. But we did have the product responding to the characteristics specified in the Shimadzu patent, and he called that largely suboxide.

When I testified in the Interference, I understood that Hall was trying to get a patent on a process—I forgot whether he had a product claim in or whether he did not,—a process and product, if he had both claims.

JACOB HOELZLE was called as a witness on behalf of Defendant, and having been first duly sworn, testified as follows:

Direct-examination.

By MR. MORRIS:

I am employed by the Electric Storage Battery Company. I have been so employed for twenty-three years. I served the Electric Storage Battery in the capacity of sheet metal worker. I have been in that same capacity for the twenty-three years I have been there. I remember the installation of the so-called German mill in Philadelphia by the Electric Storage Battery in a building near the offices, at 19th and Allegheny Avenue. I saw the mill after it arrived. I did see the mill; I did some work in connection with that mill. I had something to do with the installation of a stack or pipe upon the top of that mill. The pipe was made of sheet metal, it was made fast to a hood over the top of the machine, and led through the roof. I know the size of that pipe. The diameter of that pipe was five inches. At

your request I made an examination of that roof a few weeks back, I have forgotten just when it was, September perhaps of this year. I found the hole still in the roof, through which I inserted that pipe. It is covered with sheet iron and also covered with rubberoid roofing. I did measure it at the time I was on the roof just a few weeks back, and that told me that the pipe that I had installed was a pipe of five inches diameter. I can fix the time of this as within one, two or three years after my daughter's birth, and she is twenty-one now.

Cross-examination.

By Mr. Whitcomb:

I haven't any definite records, written records of any kind.

Benjamin Shablin, was called as a witness on behalf of Defendant, and having been first duly sworn, testified as follows:

Direct-examination.

By Mr. Morris:

My occupation is Laboratory man, and I work for the Electric Storage Battery Company. I have been employed by the Electric Storage Battery Company since July 3, 1916. When I began work with the Electric Storage Battery Company, I was casting lead balls, at 19th and Allegheny Avenue in Philadelphia for a Tudor lead machine. The Tudor lead machine was making lead dust. About six weeks from the time of my employment it began to make lead dust. The mill had a drum

in it. The drum was rotating. The mill was operated under the direction of Mr. Kershaw. We made a supply of lead balls and put them in the drum, and the drum was rotated and we were getting gray oxide from the chute. The chute is marked. (The witness indicated the part on the drawing, Plaintiff's Exhibit 43.) That is the supply chamber. That which seems like a hopper at the left-hand end of this drawing; that would be the way the balls were fed into the machine. That was the supply chamber. Gray oxide came out of the drum, right through the screen, through that chute, there was a screen surrounding the drum in which the balls were; the gray oxide came through the screen and down through a chute into a drum. In the beginning we sometimes had a wooden skid for the drum, in which the final powder was. But that material used to get red hot, charred the bottom of the skid, so we had to move that and put an iron truck under that. In the beginning we placed the drum in which the powder eventually went upon a wooden skid, and we found that the drums would get so hot that it charred the wooden skid. So much so that we stopped using the wooden skid and took a metal truck.

I know that a stack or pipe was put on the top of the jacket around the mill. I can fix the time within which it was so placed as about the middle of September, 1916.

Q. You can or cannot give me an exact date?

A. Why, we make three runs, from the day we made a supply of ten thousand balls, we made the first experimental run,—

Q. Yes.

A. —then we made about three or four runs, that would require to do it, we used to shut the mill every

week, so I would say for the time about the middle of September, possibly a few days later.

Q. Middle of September is your estimate and the best estimate you can make, is that it?

A. 1916.

The reason that I estimate that it was 1916 is that 1916 was the date of my employment. I have no other record except the log sheets showing when these runs were made, in fixing the date of September. But that is the way I fix the middle of September or thereabouts. There was some ventilation opening at the bottom of the chute, near the delivery tank. It was a hole about three inches in diameter, we had a lid over that and used to operate it by increasing or decreasing the size of the hole. I remember what difference it made in the operation of that particular plate or baffle over this lower opening when we installed the stack. The material wasn't hot any more, it was coming down more uniform and finer in particles, and it wasn't getting hot inside the drum. It didn't get so hot inside of the delivery drum. We only had it closed the width of a match stick, the thickness, somewhere around an eighth of an inch. Sometimes it was closed so that the opening was only about the thickness of a match stick. The width of the opening was only about equal to the thickness of a match stick. I will describe the mill so far as I haven't already covered it. The mechanical construction of the mill I really don't know, because I didn't put it up in any way. We took it apart once or twice to clean the screen but the operation of that is the only thing I can describe, the delivery of the gray oxide, the lead dust, and practically everything Mr. Morris here described was the thing I had to tell. I have memory what it is. In addition to what I have already said, we used to make that to fill up two or three drums and deliver that to the pasting depart-

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ment, had a few stops during that period, and then about that chimney, up.

Cross-examination.

By Mr. Whitcomb:

At that time, up until September, I had seen the drum inside the mill, we cleaned the screens. I didn't get in there, but cleaned the screens. The diameter of the stack that went up the top I should say was four or five inches. It was a little smaller than the inclined outlet pipe. The pipe went right from the center. It was about four or five inches. The pipe coming through the roof was, I would say, about four or five inches. (The witness indicated the pipe by drawing lines on Plaintiffs' Exhibit 43.) To the best of my recollection those two lines are all right to represent the stack. There was no fan to blow this air in. We had to decrease the air, not increase it when we put the stack on, so that, I presume, not as much air went in as before.

I was in the Army at the time that mill was scrapped, I believe, I am not sure though. I went in the Army in 1918. When I came back I wasn't employed any more in that particular department. I have a record as to when I went in the employment of the Exide Company. It was the third of July, 1916. That was my first holiday in the United States, my first holiday here.

Re-direct-examination.

By Mr. Morris:

I ran this mill at every noon hour.

GEORGE M. HOWARD was called as a witness on behalf of Defendant, and having been first duly sworn, testified as follows:

Direct-examination.

By MR. MORRIS:

I am employed by the Electric Storage Battery Company. I have been so employed since September, 1895. I am in the Department of Development and Design, one of the divisions of that department. I don't know exactly how long I have been in that department, about thirty years, I guess. I was in that department in the 'teens. In that department I had something to do with the processes for pasting plates. (Paper entitled "Factory Process for Mixing Lead Dust Exide Positive Paste" was shown to the witness.) It is a factory process for mixing lead dust Exide positive paste, dated November 28, 1916. I do know what the words "lead dust" in that paper mean. They mean the product of the lead dust mill that was being operated under Mr. Kershaw.

(Counsel for Defendant thereupon offered in evidence as Defendant's Exhibit No. 76 the paper entitled "Factory Process for Mixing Lead Dust Exide Positive Paste", dated November 28, 1916, which was received in evidence and marked Defendant's Exhibit No. 76.)

I made a calculation to show the number of C. C.'s of water to three hundred grams of lead, carried out according to this formula. The calculation showed in C. C.'s 47.3. This was sent to the superintendent's department by me with a note asking them to make paste according to this process. I had authority to do that.

(No Cross-examination.)

WILLIAM ERNEST KERSHAW was called as a witness on behalf of Defendant, and having been first duly sworn, testified as follows:

Direct-examination.

By MR. MORRIS:

I am connected with the Defendant in this case, I have been since the fall of 1906. I am in the Department of Development and Design, with the title of engineer in charge of research. I have been in that position since about January, 1915.

(A book was shown to the witness.) This is a note book which I used in connection with the operation of the lead dust mill installed in 1916 at 19th Street and Allegheny Avenue. It contains the first notes of the operation of the mill and the directions given me by Mr. Smith as to how the Germans operated the mill, et cetera. The mill referred to is the mill made, I believe, from German drawings. Anyhow, it was reported to me to be a copy of the German lead dust mills as operated by them for some years. The lead dust in question was the product of that mill. The mill consisted briefly of a rotating drum, supported by trunnions, carrying on or in its periphery a large number of small holes about one-eighth of an inch in diameter. The trunnions on which it was supported were hollow, so as to permit the introduction of material into the drum. One trunnion was hollow, and I am not certain about the other. I will have to apologize. The drum was approximately five feet in diameter, by three feet wide, that is in length. The drum was supplied with flanges attached to its periphery at either side, or either end, if you are referring to the horizontal dimension, which carried a screen, the screen, of

course, rotating with the drum. There was a casing around the drum, which at the bottom became funnel-shaped, and ended in a delivery pipe running down to whatever receptacle was placed for the receiving of the product. Turning to the operation, balls approximately five-eighth inch in diameter of lead were fed in through a trunnion until the load of approximately two thousand pounds had been supplied, and the mill was then put in operation, and as the balls became turned into the oxide product the load was maintained by feeding in from time to time more balls to keep the load somewhere near some figure, around eighteen hundred to two thousand pounds. The moving parts of the mill were the rotating drum referred to... We usually started the operation at the highest speed we could obtain with the drive, which was about fifteen revolutions per minute, and then as the temperature—

THE COURT: By the way, what was the speed of the plant that I saw operating this morning?

MR. STOUGHTON: Fourteen.

THE COURT: Fourteen.

(Continued) As the temperature rose the speed was reduced. The operating speeds were usually between eleven and thirteen revolutions. The lead balls are chunks that were fed into the mill, and were approximately five-eighth inch in diameter. After they got into the mill they actually became abraded, due to the operation of the mill, and became smaller and smaller in diameter, so that at any time after, any considerable time after the first starting of the mill there would be balls of all sizes, from five-eighths of an inch down to the size of a small pea. In Plaintiffs' Exhibit 43

there seems to be classification of the balls in size. That is all right. From viewing the contents of the mill when it was not rotating, after stopping at the end of a run, I can't say that I received any impression that the large balls were always on top and the small ones underneath, as shown there. There may have been a tendency in that direction, but I didn't get that impression. Turning back to the operation, on starting the mill with a fresh charge, the mill being, of course, cool, and the balls all of one diameter, the product for some hours would be a very black, velvety powder, with a very marked tendency to ignite on coming in contact with the outer air. That, I believe, was so much the case that to my present recollection we never started up with new balls in the mill without having the material catch fire, either in the delivery pipe or after it reached the receiving drum.

The mill was put into my direct charge by Mr. Ford, who was then in charge of the Department of Development and Design. I did receive information with regard to its operation at the time I was put in charge. Turning to my note book, I find under date of June 5, 1916 notes which I made from information given me by Mr. Smith on that date, and from his notebook which he showed me, as to how the German Company operated their mills. I made that note book entry on June 5, 1916.

(Counsel for Defendant thereupon offered in evidence as Defendant's Exhibit 77 pages from the note book of the witness Kershaw, which were received in evidence and marked Defendant's Exhibit No. 77.)

Mr. Betts: We object to that, your Honor,

what the witness wrote down, what someone else told him about what was done in Germany.

THE COURT: Well, I will note the objection, of course, and take it subject to the objection.

In this exhibit, this note book which I am about to read from, is a description of the process given me by Mr. Smith. It was my information at the time that it represents something that he saw in Germany. It does not contain an order to me to do anything.

THE COURT: All right, well, I will take it subject to the objection.

The witness resuming, testified:

It is headed "Lead Dust", mill 800 to a 1000 kilos, contains 1765 to 2204 lbs? start, 800 kilo., start at 15 revolutions per minute. Temperature of air inside cases 65 to 70 degrees centigrade. Hold 68 to 70 degrees centigrade. Above those are Fahrenheit figures, that is, 65 to 70 centigrade corresponds as I have it noted here to 149 to 158, F. And the 68 to 70 centigrade corresponds to 154 to 158 Fahrenheit, as I read it. It is very faint. Speed, 13 to 15 revolutions. Control temperature and also weight of material inside. Run for about two days, throwing away product, but weigh what comes out and add lead on basis of two to four per cent gain in weight. In starting use entire new charge, emptying out old through hand hole. Final product analysis 95 to 96 per cent lead. Output, 15 to 20 kilograms per hour. Above those are figures which translate them into pounds, but I can't read them in this light. A kilogram equal about two and a third pounds, so that is about twenty-five to forty pounds, I think, but I can't read it. Mill cold equals coarse powder. More balls equals finer powder. More speed

equals coarser powder. Must be used within three days after being made, even though almost hermetically sealed. Specific gravity is kept between 2.1 and 2.2 (Scott volumeter). Below that is the standing order under which this operation was carried on, that is, the Electric Storage Battery Company's standing order 432 V, the building number, building number 24, and two plant order numbers under which work could be done on the mill, the first, 16732, and the second, 17953. Under that I find a note, bulb for recording thermometer takes one-half inch pipe thread. Another note, second floor, Meyer; proper name, M-e-y-e-r. At the bottom of the page, under the heading "Pasting", one kilo to 165 grains of four degree Baume acid equals 1454 C. C.'s of 1.0284 acid to 20 pounds, equals 72.7 C. C.'s per hour. Ninety-five per cent of lead in the material figured as PbO would be approximately Seventy per cent PbO, and ninety-six per cent Pb, calculated as PbO, would give you fifty-six per cent PbO. Turning to the entry at the bottom of the second page, I have or have had translated into C. C.'s of water 300 grams of lead. It comes to 47.3 C. C.'s for 300 grams of material.

Turning to Defendant's Exhibit 16, under date of August 3, 1916 there is a record of the mill operation. It gives the time of starting, 2.35; the temperature as 85; weight of drum, 65 pounds; 15 revolutions; finished 4.40, temperature 121; 15 revolutions, gross weight, 156 pounds. Defendant's Exhibit 17 in the same note book under date of August 17, 1916, is 15 Hycap positives, stamped LD 1 A, air dried; 15 Hycap positives stamped LD 1 B, pickled; 60 pounds of lead dust, small mixing machine. Then follows a calculation of the

amount of acid required for sixty pounds of lead dust, which comes to 4,362 C. C.'s of 1928 acid, mixed ten minutes, made into smooth paste, easily pasted, pasted on cloth like negatives. Weight of 10 wet plates, 19.4 pounds. Weight of 10 grids, 7.1. Turning to the first line under the date in that, I read "15 Hyc.", 15 Hycap, and the plus mark following Hyc. stands for positive. The LD stands for lead dust. Lead dust means the product of this mill which we operated at 19th Street, and which I believe to be a copy of the German mill. I have not made a calculation of the C. C. of water to 300 grams of product shown by that entry. I have no doubt that it is substantially the same as the calculation at the bottom of my first page. I will accept that, subject to correction.

The mill was set up when I was first given charge of it. There was no stack or vent on top, when I was given charge of it. It had an outside casing. I told you that it had a screen between that casing and the rotating drum. As shown on the Plaintiffs' diagrammatic section, the outlet is not correct. I believe a correction has already been made, which is approximately correct. The outlet to the drum as originally shown in this sketch, Plaintiffs' Exhibit 43, is not correct. There was a hood, as shown in correction B, that was attached to that outlet. I am referring to the receptacle into which the material is ultimately discharged as the drum, in that instance. The function of the hood was to prevent too free an access of air to both the receptacle and the material in the mill above. I agree with Mr. Ishimura, Dr. Clark and Mr. Smith, that there will be no product at all by rotating lead balls in an inert atmosphere. I am in thorough agreement with

them. I did get a product from this mill. I can describe the product. As I previously testified, the product at the start of a run would be almost jet black in color. That color would vary as the run proceeded and the temperature of the mill came up to a rather dark olive green, at which we habitually stabilized conditions so as to continue to obtain that product. Of course, on experimental runs we went to higher temperatures and higher oxidations, in which case the product tended to become a somewhat yellowish green in color. As to its reactivity, the black powder ignited most easily, the green and yellow powder could be ignited, that is, the yellowish-green powder produced by this mill could be ignited. The material oxidized very readily when it became wet, and in bulk on wetting it sometimes produced enough heat to start an actual incandescence in the mass of material. I had the oxygen content of these calculated, and I calculated it, both. The lowest analysis calculated as PbO that I recall was about 44%. I do not know offhand what that would be if it were calculated as Pb_2O. We ran in oxides calculated as PbO as high as a little over eighty per cent. I observed that the higher the oxidation the lower the reactivity, and the lower the oxidation the higher the reactivity. I operated this mill on July 25, 1916, when we began some experimental runs, until the middle of 1917. I personally operated the mill until the end of the week ending June 17, 1917. There was a further run in August, but I wasn't present. There was a run recorded, on the mill sheets, mill log records. I think that they will be in evidence. Mr. Shablin, who testified, a Mr. Kahn, who was my assistant at the time, and Mr. Shemberger and Mr. Gallag-

her assisted me in the operation of this mill. Mr. Shablin is the only one who is still with the Company. Our treasurer's department record shows that Mr. Gallagher left on April 12, 1918. They show that he was employed August 7, 1916. With respect to Mr. Kahn, they show that he was employed in February, 1916, and left on August 24, 1918. Mr. Kahn was my assistant in the operation of the mill and had charge of the men when I couldn't be present. Mr. Shablin was principally employed in casting balls, but took charge of the mill during noon hours; Shemberger and Gallagher had twelve-hour shifts, in actual operation, with the exception of the noon hour, when Bennie Shablin took charge.

Within limits we were able, as a result of our experience, to stabilize the mill very nicely to whatever product we desired. I did make a report to the Company with respect to the results of my work. That report was made July 24, 1917. (A report was shown to the witness.) This is the original typewritten copy of that report. It was made to Mr. Ford who was in charge of the Development and Design Department of the Defendant Company at that time.

(Report of the witness Kershaw dated July 24, 1917 to Mr. Ford was thereupon offered and received in evidence and marked Defendant's Exhibit No. 78.)

Mr. Whitcomb: If your Honor please, we have an objection that we want to apply to all this testimony about a certain part of this report, attempting to establish a public use. There is no publication of this. The patent statutes require printed publication, on the one hand, or a certain

use on the other hand. Now, a mere memorandum of something which did not materialize into a structure is inadmissible for any purpose, so there are certain things that may come out, I mean, we don't like to—

THE COURT: Yes, that is all right, I will understand that that objection applies to all the testimony offered along those lines.

MR. WHITCOMB: Yes.

The witness resuming, testified:

As given in this report, the specific gravity figure was from an estimate by what we call a bumpometer, in other words, it represents a packed weight. The Scott volumeter is an unpacked weight in a cubic inch. In comparison, the Scott volumeter reading is naturally lighter than the bumpometer reading: by roughly one-half. That is, the bumpometer test is about twice what the Scott volumeter reading is, so that the apparent specific gravity when the material is not packed in the receptacle in which it is measured would be 1.5 to 2., under item "C". That is apparent specific gravity. This is the tube which is referred to as "K" (indicating on Plaintiffs' Exhibit 43.) It is the tube just opposite the letter "B". It is the diagonal tube. (Mr. Whitcomb marked Plaintiffs' Exhibit 43 with the letter "K". These letters in my analysis, these letters to the right of the page and the various items that are lettered there, go to produce certain characteristics of the product. They are either parts or methods of control that produce the various characteristics that I have listed as "A", "B", and "C". The tube which I have referred to which is just above the receptacle, into which the prod-

uct is ultimately delivered, played a part in the extent of oxidation of the product, because it was there that the fresh air entered. The air being highest in oxygen content at that portion tended to oxidize the material further than the partially exhausted air which would be found up in the main mill. The air passed up the tube, which has been marked "K" on Plaintiffs' Exhibit 43. If it had not entered somewhere there would have been no product. If the top of the mill had been hermetically sealed, it could have been hermetically sealed and no air admitted through the tube "K", there would have been no product.

With respect to the casing surrounding the mill, after the mill had been in operation a few weeks it was found advisable to put a pipe or stack or chimney on the top of that casing up through the roof of the building, so as to accomplish two ends. One was to gain a better control of the air flow through the mill, and the other was to change the air pressure on the inside of the casing near the top from a positive pressure to a negative pressure, so that instead of air leaking out into the room and carrying dust with it, the top of the mill was under slight suction, with proper regulation of the draft, and any leak would simply admit a little air to the casing instead of allowing the lead dust to leak out into the room. I know positively I did it. It was done in the fall of 1916, I can't fix the exact date.

I have heard the testimony about the sale of batteries to the New York Railways made of dust of this machine, the product of this machine. I can swear that the stack was in place before we made any material for outside use.

There was a damper in the stack for the better control of the air. Turning back to page two

of my report, the screen referred to in the middle of paragraph entitled "J", is on the periphery of the drum, and I have no reason to change what I said here about its function, that its function is not to sieve the material but to assist in the proper oxidation. We made runs and produced usable material without any screen on the drum. The initial runs bear a very direct relation to those figures given me by Mr. Smith, as recorded in my note book, "Defendant's Exhibit 77." They are not exactly the same, of course, but they show that during that period I was operating quite close to the German instructions. Page 3 of my report, second paragraph, is the paragraph reading "Control the character of the product as far as possible by the external and internal ventilation systems, installing fans if necessary". We did not actually install any fans at that time. I did have it in mind for controlling the ventilation, as an improvement. As to what we did to control the product, we could, of course, change the load either up or down by either failing to put more balls in the mill or adding more balls. We could change the ventilation. As it first operated we had not any control over the air, but after putting in the stack we had a very excellent control over the air in the damper in the stack. There was also a control through small lids which could be so adjusted as to cover partially or completely the holes in this outlet leg. I mean the receptacle hood. The holes were for the admission of air, the holes in the hood as shown there were for the admission of air to the mill. I mean this little point which you are marking "M". That would be a depiction of one of the holes, the other marked "N". I had control of the openings that are marked "M" and

"N" respectively, on Plaintiffs' Exhibit 43. I had small adjustable lids which could be slid to one side so as to open those holes or slid to the other side to close them practically completely.

By THE COURT:

Q. You don't say anything about that in your analysis. It would be under "B", oxidation, wouldn't it—temperature of and ventilation, well, perhaps that is under temperature of and ventilation through the machine?

A. Under "H"—

Q. "H", yes.

A. —if your Honor please.

(Counsel for Defendant here offered in evidence as Defendant's Exhibit 79 four pages numbered A, B, C and D of the witness' original note book, which were received in evidence and marked "Defendant's Exhibit 79".)

The date of the first sheet of Exhibit 79 is August 7, 1916. On page 2, I find screen tests made on German lead dust. I mean that the material was put through a nest of screens. This lead dust is material received from Germany, samples received from Germany. It contrasts with the E. S. B. lead dust on the following page. In the first, under examination of the lead dust which was imported from Germany, we got certain tests on one cubic inch of weight. That weighs 32.277 grams. Sixty mesh screen means sixty meshes each way, so to get the number of holes you multiply sixty by sixty. And one hundred and ninety mesh screens means one hundred and ninety holes each way. And the holes per square inch would be one hundred and ninety by one hundred and ninety. I think the number of holes in a two hundred and sixty

mesh screen was about fifty-seven thousand. That is translated into percentages in the right-hand column, that is (indicated by counsel) what was on the bottom of the pan. The calculation of fifty-seven thousand six hundred is correct. The screen test was with a set of nested screens, and by that I mean that they were placed one above the other and held together by the bottom one nesting into the top of the next, the lowest in the nest being a solid bottom and called the pan here. The percentage of the cubic inch of material with which we started which was found on the bottom pan as having passed all those meshes in the No. 2 sample, was 55.7, and the No. 3 sample 76.6 per cent. On the number 2 the specific gravity was 2.046 on the Scott volumeter. On the number 3 sample, the specific gravity was 1.804 by the Scott volumeter. Turning over to the next to the last page of Exhibit 79, the material with which I started out there was lead dust of our own manufacture; that is, made in the Nineteenth Street lead dust mill under my supervision. The manner of the test was exactly the same. The percentage found in the pan in the No. 1 E. S. B. lead dust test was 72.5. That was No. 1. And the specific gravity of that was 1.813. That was before screening. That was the specific gravity of the material with which we started obtained by a Scott volumeter. The third column is the amount that remained on the sixty mesh screen. We started out with an actual weight of 29.7 grams. That is the weight and not the percentage.

You got 72 per cent to the pan, so your dust was finer than the German dust, wasn't it?

A. Well, I—

Mr. Morris: Finer than the German No. 2?

The Court: Yes.

MR. MORRIS: Not quite so fine in that one as in the German No. 3.

The E. S. B. lead dust No. 2 is the same process. I will have to correct the former statement. The multiplication of the two hundred and sixty mesh is sixty-seven thousand six hundred. The number of holes in the two hundred and sixty mesh screen is sixty-seven thousand six hundred per square inch. Passing back again to the test of E. S. B. lead dust No. 2. I calculated last night the percentage of the cubic inch which passed into the pan through these three screens. That was 76.5 per cent. So that that corresponded within one-tenth of one per cent of that in the German No. 3. The specific gravity of the No. 1 E. S. B. lead dust was 1.813 by the Scott volumeter. Turning over to the last page, we obtained the specific gravity from those weights by dividing the Scott volumeter in grams by the weight in grams of one cubic inch of water, namely, 16.38, you can obtain the apparent specific gravity. So that, to translate the weight of the cubic inch, you have the weight shown on this page. The weights shown on this page (indicating are the weights of one cubic inch. Dividing that by 16.38 gives you the specific gravity of 1.91. The same would apply to the sample at four P. M. of eight sixteen. These are all consecutive pages in the note book. The first entry is August 7, 1916, and on the last page the entries show that Scott volumeter readings were made on material made on August 16th, 17th and 18th of 1916. The specific gravity of the sample at four P. M. on the last page of Exhibit 79 would be approximately the same as the preceding one. It would be just a trifle more because you have the figure to be divided by 31.87 at the top of the page and your divisor is the constant factor of 16.38.

Shortly after we started operating, we began making weekly log sheets of the runs and they were regu-

larly kept until the mill was shut down. The first one is August 13th to 19th, 1916. That shows the temperature as recorded inside the casing at the top of the mill. At Nineteenth Street in Philadelphia of which I have ben speaking, mainly. I have a marginal note on the left-hand side of these sheets. The temperature of the mill on the date when we began recording was 141 Fahrenheit. The marginal note says times ten, equivalent weight of balls per hour, weight of dust per hour, temperature, and per cent of PbO. In other words it means that the 14 is to be multiplied by ten. In other words, read as 140. That is 140 Fahrenheit. Translated into Centigrade, it is exactly sixty. Sixty times eighteen, that is one hundred and eight, add thirty-two that makes exactly one hundred and forty Fahrenheit or sixty Centigrade. It was 141.

THE COURT: Now, don't you think I can see all that Judge, without reading all that into the record? I mean, it's so easy to see from that graph.

MR. MORRIS: Yes. Well, I think that is about all we need, except the load in the drum, which I think is calculated on the right-hand side. The entries are there.

THE COURT: Yes. There's the weight of dust per hour, the equivalent weight of balls per hour that's in the drum.

THE WITNESS: No. This is the weight of the product per hour produced and the weight of the balls fed into the mill,—

THE COURT: Oh, yes.

THE WITNESS: So as to maintain the load at the same figure.

THE COURT: Yes.

THE WITNESS: That would show, in this case, that we started at about fifty pounds and averaged a little over forty pounds in our production while the mill was run.

THE COURT: You went down pretty low here (indicating) to twenty pounds.

THE WITNESS: That's the ball feed.

MR. MORRIS: That's what?

THE WITNESS: The ball feed.

THE COURT: That is ball feed, that's right, I got them mixed up. That is the ball feed, and the dust is pretty regular.

MR. MORRIS: I think there is nothing else that needs explanation there?

THE COURT: No.

On the second sheet already in evidence as 18-E, the notations at the bottom show that we started at a temperature of 105 approximately. It took from six A. M. Monday to approximately six P. M. Monday to get up to where we were going and then the curve speaks for itself thereafter.

L. D. No. 3 stands for lead dust No. 3. It is the third lot of experimental plates pasted on the date shown below, August 22, 1916. And the same thing as to L. D. No. 4. The graph in the lower right-hand corner shows that there was a record lost in there. That is the weight of the dust, and he equivalent weight of balls, and we got the same thing in all of these. The L. D. entries on all of these are for showing the samples pasted on the experimental plates. The pasting date is given below each one. Referring to the one for

twelve, thirty-one sixteen to January 6, 1917, the note there "No screens used during this week" refers to the screen on the periphery of the mill. In other words, that screen was taken off and a product was made without it. That is the revolving screen on the periphery of the mill. Referring to the one of February 4 to February 10, 1917, the bottom note reads: "Damper in flue closed at two P. M. Outside openings around delivery pipe were tightly closed". There is something on some of these later sheets. The oxidation curve which shows up on those sheets, I don't know whether that is in.

Q. Some of the subsequent sheets have a PbO percentage. I have one before me, one, twenty-one, to one, twenty-seven, 1917. Those sheets merely show, do they not, the percentage of oxidation calculated as PbO?

A. That's correct.

Q. Was there one in here in which the specific gravity was calculated by the bumpometer test, do you know?

A. The specific gravity, when given on these sheets, is given in terms of the bumpometer reading, so that, to get it into the apparent specific gravity of a Scott volumeter or as shown in the patents, you divide it by two. Of course, neither one gives an absolute figure. But that would give the approximate test as indicated in the patent in suit.

Mr. Morris: Direct-examination closed. Oh, yes. These graphs I offer, as a whole, as Defendant's Exhibit No. 80, and they consist of thirty-one sheets. They consist of thirty-one sheets, and it is Exhibit No. 80. That consists of thirty-one graphs of log sheets of the German mill, so-called, operated by E. S. B. at Nineteenth and Allegheny Avenue in the years 1916, 1917 to and including five, twenty—five, eighteen, 1918.

(Thirty-one graphs of log sheets were marked as Defendant's Exhibit No. 80.)

Mr. Whitcomb: Are you going to introduce this note book?

Mr. Morris: As an exhibit, it went in, a copy of it, but you can use the original if you want. We would like to have the originals but they are subject to the Plaintiffs' inspection at any time, if that is suitable to your Honor?

The Court: Yes.

Cross-examination.

By Mr. Whitcomb:

These curves on Exhibit 80 were prepared week by week as the individual mill sheet reports were sent up to my office. This mill produced on the average of between forty and fifty pounds of lead dust a hour in the regular production. According to Dr. Wilson's report in this case, that our present mills produce about eleven hundred or twelve hundred pounds in order to produce the same amount as produced by our mills now, you would have to have about thirty of these. That sounds correct. The way we ran the original mill we showed, on experimental, a production up to eighty pounds; but you asked me the average. Here is one that shows seventy-five. It is the record of February 4th to February 10th, 1917. I think—I beg your pardon, I am wrong on that. Just wait a minute. One, twenty-one to one, twenty-seven—shows it sixty-five. Four, twenty-two, to four, twenty-eight, 1917 gets up to eighty. That's the sheet I was hunting for. It goes to eighty or eighty-one pounds. The dust contained various quantities of small lead pellets. That would make it less weight per hour. The same volume,

if it was fine, would be more than if it was coarse. But we are simply taking what was produced. I cannot say whether it would make the weight heavier or lighter. If we had produced the same volume of material and it had all been fine, it would have weighed less because the gravity of the lead pellets, the apparent density. Of course, it would depend on how tightly the dust was packed. The highest production we showed per hour was eighty pounds. Even at eighty pounds per hour, as compared with our present machines, that would require about fifteen of these mills to product the same amount we produce per hour now. Some of these runs were for production, and some of them were for experimental; frankly, experimental. This particular one was one of the experimental runs—that was not made for production—I made to establish how high a production we could get. It was not put into production plates. It wasn't a very good product; we didn't like those lead pellets.

I understand that this very mill was finally scrapped. I don't know that it was of my own direct knowledge; only by what I have been told. I am willing to agree that it was, yes.

The size of the holes in the main drum was approximately an eighth of an inch, if you are discussing the small holes in the periphery of the main drum. It seems that any particle an eighth of an inch could go through it. We had particles an eighth of an inch only when we ran without a screen. The biggest size we had with the screen was whatever the screen would let through, namely, if you had a sixty mesh screen, there was a particle corresponding to that in size. The grading effect of the screen was of a very minor nature. As to the difference of what would pass, an eighth of an inch and sixty mesh, there is a distinction whether I am trying to make it or not due to the rotation of the mill. Due to the rotation of the mill, a

particle which would normally easily pass an eighth of an inch hole would not normally fall through the hole. The sliding action and the speed of the outside of the mill tends to prevent those particles from going through. But without the screen, there were occasional particles of the diameter of an eighth of an inch forced through some of the holes, but they were very minor in quantity. An examination of those particles doesn't show them to be composed of solid lead. They are composed of a mixture of lead and lead oxide, and they finally, apparently, abrade. Anyhow they become of such size they will go through the screen. We were about to use the product from the mill without the screen. I would not be able to use a product containing pellets as large as an eighth of an inch in size without a secondary process of screening. Some particles an eighth of an inch in size would occasionally go through without a screen. Those we cannot use. We would not regularly use that product without some means of sorting. I would say that the proportion, drawn in pencil on this Plaintiffs' Exhibit 43, as compared with the lower delivery pipe K is in reasonable agreement.

Q. All right. I notice in several of these charts, particularly in the earlier exhibits introduced by the other witnesses, as time went along you tried to increase the loads and then dropped back. For example, if you will review Exhibits 18-A to E—will you hand me those Defendant's Exhibit 18-E, the whole bunch of 18?

Mr. Morris: Yes. They are called 18, but they should be 18-A.

Mr. Whitcomb: Yes.

The Court: It almost looks the other way to me. It looks as if they got to a certain point where they had to check the feet and drop it off.

MR. WHITCOMB: You have all the other sheets, too. I will ask you to go ahead.

THE COURT: Yes. Well, I was using both of them. It looks as if you went along fairly steady for a while and then you would have to drop it.

MR. WHITCOMB: That's what I am trying to have explained.

This record of no operation for the week of August 20th to 26, 1916, the first sheet of this series, indicates to me that we were trying an experiment there of letting the load in the drum get quite low, in order to discover just what effect that had on the type of product and the rate of production. In the next experiment in that series, Exhibit 18-B, we went up to nineteen hundred. Eighteen hundred pounds to two thousand pounds was the range of load that we normally carried for production purposes. You will find figures outside of that but they are mainly experimental or some effort to control the mill. We were not making efforts to increase the yield, increase the load and get more product out of it. My first record, I think, will show a load in the drum of around seventeen fifty; but, anyhow, we let it go down. We made an effort to increase the yield during this year on that mill. I said a minute ago that was not our main purpose at the time. We made experiments to try to increase the yield. Eighty was the maximum. I believe we could have maintained eighty with that mill. We didn't get a good product at eighty. Our top figure was about sixty for the usable product. For our present mill, twelve hundred pounds an hour, we would need twenty of the old mills to give the same yield.

By THE COURT:

Q. What I don't quite see—I don't know that it

makes a bit of difference—is why the lead in the drum will go up when the weight of the feed and the weight of the dust is just about constant. Just, as an example, take ten, one, to ten, seven, 1917—the lead in the drum apparently increases steadily, and you have got an almost constant, almost level, line there. What makes the lead of the drum go up? If you keep feeding the same amount of balls in and taking the same amount of dust out regularly, right along, why does the lead in the drum increase? That's ten, one, to ten, seven, 1916.

The equivalent weight of balls per hour as shown in ten, one, to ten, seven, 1916, is at a higher figure than the weight of dust produced per hour except at two small intervals. If those two lines were on a level, the lead in the drum could not possibly go up. The first figure I can give you as to the minimum yield of usable material is forty. At forty pounds an hour we would require thirty mills of the old type to equal one of the present.

The thermometer in the tests for temperature change for all these previous runs was placed in the top of the casing not very far from the stack. I did not know what temperature was inside the main rotating drum. The system or method we had for ascertaining the chemical analysis was this. Samples were taken, after we once got under way, at regular intervals and sent to the chemical laboratory, in most cases, although some of the earlier ones I analyzed myself. My method of analyzing was to treat some of the lead dust with dilute acetic acid and wash the precipitate lead filter—precipitate for lead in the filter, that is, the lead that had dissolved—weigh the lead and then calculate back to lead.

The figures on all these charts are not all of them mine, but some of them are. The majority are by our

chemical laboratory. In connection with the air, we never measured the amount of air passing through the drum. As I remember the witness Shablin's testimony. I recall only one o r two occasions on which we closed the lids over the lower area that is marked M on the Plaintiffs' diagram to only the width of a matchstick. Most of the time they were certainly opened a matter of ten per cent of the area of the hole. We had them closed that close at times, but that was not our normal opening though. I do disagree with him to that extent. The product manufactured in these experimental runs that we had of this mill, in my opinion, is quite similar to the material made by Hall when he began making the material from the Hardinge mill. It is not substantially different. I would say that Mr. Smith was acquainted with the character of the material at both those times. I would suppose that he was acquainted with those facts in 1927 and 1928. He must have known them in 1921 or '22, if they made it in '22, as comparing it with the material they had made at earlier times.

I didn't explain why that one sheet didn't have a record for a day there. That record was lost. There is a notation on the bottom of the sheet to that effect, I think, but I may be thinkin' of another record. The second sheet has a note at the bottom "Record lost—", I can't quite read the time here, it is a little faint; if we had the original, that would appear. The mill was not shut down, evidently.

I don't know of any company in this country using one of these types of mills today, exactly as shown. The Willard Company is, I think, and there is one in Toronto. In the United States, I don't. I think there is. I have no knowledge of that. We have heard of the Willard installation in the far West—in California, I believe. I don't know that of my own personal

knowledge. At that time or during the time surrounding the operation and production of oxides from this mill, the company was purchasing a considerable quantity of oxides on the market. I cannot say as to how that amount would compare with the amount made by the mill. I feel reasonably certain that we must have been purchasing much more than this mill made.

Re-direct-examination.

By Mr. Morris:

Q. Mr. Kershaw, other things being equal, could you make more of a product in the circular, hollow cylinder made of iron sixty inches in diameter and sixty inches in length than you could in one thirty inches in diameter and sixty in length?

A. The product would be in proportion to the length.

Edward W. Smith, a witness on behalf of defendant, was recalled.

Re-direct-examination.

By Mr. Morris:

(Counsel for defendant offered in evidence a letter headed "Lead Dust, etc.", October 3, 1919, addressed to Mr. R. C. Norberg, signed Edw. W. Smith; and two pages dated 10-3-19, headed "Notes on Manufacture of Lead Dust", signed E. W. S., Factory Engineer, which were received in evidence and marked Defendant's Exhibit 81.)

The first of these is a letter headed "Lead Dust, etc.", dated October 3, 1919; it isn't quite clear there— addressed to Mr. R. C. Norberg, who was at that time

our factory manager or something of that sort, of the Willard Company. It is signed with my name, Edward W. Smith, d B., and that is my signature, signed by William duBois, who was at that time secretary to the president and authorized to sign my name. The second and third sheets are notes on the manufacture of lead dust, dated tenth month, third, 1919, and signed by me, E. W. S., by my initials, and in my writing. I recognize that as my personal signature, by initials. I recognize this third document as Kershaw's notes but I don't know the exhibit number. Here's the date—seventh month, twenty-four, 1917.

Re-cross-examination.

By Mr. Whitcomb:

I haven't the least idea when I first knew about Mr. Kershaw's memorandum of 7-24-17; probably near the time he wrote it. Probably at the time he wrote it, yes. I think it was, but I have no definite recollection of it.

Willard H. Reinhardt was called as a witness on behalf of defendant and, having been first duly sworn, testified as follows:

Direct-examination.

By Mr. Morris:

I am connected with the Willard Storage Battery Company. My office is at Cleveland, Ohio. I have been connected with the Willard Storage Battery Company since June 10, 1918. My position with the Willard Storage Battery Company is chief engineer. As chief engineer I have supervision over research and

development work, design and inspection and testing of the product and materials.

The papers marked Defendant's Exhibit number 81 were handed me some time in 1920 as my instructions for operating the German lead dust mill. That was the designtaion that was given this mill from the time that we started to operate it, the mill we operated in Cleveland. The mill came from Philadelphia, the Electric Storage Battery Company. I find the following instructions that pertain to its operation in the letter to Mr. Norberg signed Edw. W. Smith by Mr. DuBois. (Reading) "I am sending you herewith a few notes on the subject of lead dust manufacture, some of them by our laboratory and a few others of rather more general character by myself—" I did examine those papers prior to our operation of that mill. I likewise examined the third paper, which was shown to be Mr. Kershaw's notes of seven, twenty-four, 1917, before we began the operation of the mill. Then we built a special building in Cleveland and started to operate it the latter part of May, 1920. It was the mill that I mentioned before as the German mill. I have some drawings which will show what the mill consisted of. At the same time the instructions were handed to me, there was handed to me a blue-print with the designation S. F. 1176. I have a photostat of the blue-print. This (tendered by counsel) is the original. It represents the mill which we were instructed to operate.

(Blue-print S. F. 1176, tracing made from Abbé Engineering Company's drawing A-328, dated July 24, 1915, was here offered and received in evidence and marked Defendant's Exhibit number 82; Blue-print 4646-YX, assembly of lead dust mill, Willard Storage Battery Company, was also

offered and received in evidence and marked Defendant's Exhibit number 83.)

I received the paper, Defendant's Exhibit 14, at the same time I received the other information regarding the mill. Defendant's Exhibit 83 is an assembly drawing of the mill that we operated, and this drawing was made by the Willard Storage Battery Company. There is a date here on this photostat, but it is dim, I can't make out what it is. (The original drawing was shown the witness.) This is dated 10-22-19. The next one is the layout for reinforced steel for lead dust building.

MR. MORRIS: I don't think 84 is any good anyhow, and I will withdraw it.

I have examined all of these exhibits from J down to P. Those are correctly labeled with what they are, that is right. The dates on them are not the dates when I received them. Those are the dates when the last ones of these that are marked "Willard Storage Battery Company" were made in the Willard Storage Battery Company's drawing room and the others were the Exide prints and the Abbe Engineering prints, and letters of Mr. Smith and his notes were given to me some time in 1920. All of these prints relate to the lead dust mill that we operated in Cleveland in 1920. We didn't build the mill, it was shipped to us from Exide, but they are the prints from which it was set up and ready for operation. And we used those prints, that is right.

(The following documents were thereupon offered and received in evidence and marked as indicated:

Drawing of Willard Storage Battery Company entitled "Layout of North West Corner

Property—Taft Avenue, Lead Dust House", dated 9-21-19, was marked Defendant's Exhibit number 84.

Drawing of Willard Storage Battery Company, entitled "Steel Details for Lead Dust Bldg.", dated 9-30-19 was marked Defendant's Exhibit number 85.

Drawing of Willard Storage Battery Company, entitled "Details for Lead Dust Mill—Taft Ave.", dated 10-20-19, was marked Defendant's Exhibit number 86.

Drawing of Willard Storage Battery Company, entitled "I Beam Clamp for Chain Hoist", dated 5-7-20, was marked Defendant's Exhibit number 87.

Drawing of Willard Storage Battery Company, entitled "Details for Lead Dust Mill, Taft Ave.", dated 11-20-19, was marked Defendant's Exhibit number 88.

Drawing of Willard Storage Battery Company, entitled "Details for Lead Dust Mill, Taft Ave.", dated 10 23 19, was marked Defendant's Exhibit number 89.)

Coming to the exhibits which follow in my book, there is in these, the remainder of these exhibits, a report from the mill operator on the output and input of the machine and the temperatures, and in some cases deliveries of oxide to pasting department.

(Counsel for defendant thereupon offer in evidence paper entitled General Factory, Department Dust Mill, dated 8 19 and 8 20, which was received in evidence and marked Defendant's Exhibit number 90, and shown to the witness.)

This is a report prepared by the mill operator cov-

ering the time of 8-19-20 to 8-20, beginning at 6:30 A. M. on 8-19, and it gives the amount of lead balls added to the machine, and the amount of litharge produced, and the temperatures every hour. There is also a note there on the time lost during the day.

(Counsel for defendant offered in evidence page from mill operator's notebook, dated 8-19 and 8-20, which was received in evidence and marked Defendant's Exhibit number 91 and shown to the witness.)

That is a photostat of the operator's own notebook covering the operations of the mill. The dates are specified there somewhere. "Out" and "in" on the first sheet means the amount of material out of the mill and amount of material in, that is pounds of balls. Those are some other person's notebooks. They were made under my supervision, and from this notebook that he had here he made these daily reports which were delivered to my office. They constitute a part of my company's records.

(Counsel for defendant offered in evidence tabulation entitled "Lead Dust", covering dates from 6-22-20 to 8-25-20, which was received in evidence and marked Defendant's Exhibit number 92 and shown to the witness.)

These two sheets disclose a summary of our operations for the time that we operated the mill. I think it might be well to explain, take 6-28-20. The top is headed "Pellets added to the machine"; the next column is litharge. The top, the first column after the date, is "Pellets in Machine". That means pounds, not number of pellets. That is what he put in during the time that the machine was operated. The next col-

umn is litharge from the machine, it is headed "Litharge from Machine", 1056 pounds. And the next column is load of the machine, that is, the amount of material that we calculate that is in the machine at that time, and the next column is the average temperature, it is the average of the hourly readings; and the next column is the number of hours that the mill was operated, and the last column is output in pounds per hour. The last figure on the second page is 56.3. That is beneath the notation "Average output per hour". Nothing else on either of those two sheets requires any explanation.

(Counsel for defendant thereupon offered in evidence paper entitled "Willard Storage Battery Company, Chemical Laboratory Report, Text No. 1496", which was received in evidence and marked Defendant's' Exhibit number 93, and shown to the witness.)

Apparent density as given there is grams per cubic inch. And you have to divide that by 16.38 to transpose it into grams per cubic centimeter, the apparent specific gravity. I don't have those several items in terms of PbO on my notes. This is the chemical analysis of the product of the mill, produced on that particular day. I have those calculations in my portfolio there if somebody will hand it to me. (A paper was shown to the witness.) From the total lead analysis on the sample of 8-11-20, we find that calculating the oxidation in terms of PbO we have 87 per cent, for the first line. The second line is 71.7. The third line is 89.5. The next line is 66. The next line is 74.5; the next to the last line, 89.5; the last one 80. That is percentage of oxidation calculated as PbO.

(Counsel for defendant offered in evidence a

paper entitled "Test Instruction Sheet, Engineering Department, Test No. 1496", dated 7-30-20, which was received in evidence and marked Defendant's Exhibit number 94.)

That is a test instruction sheet issued by myself on 7-30-1920, authorizing the chemical laboratory to make—that is the one on which the last exhibit was made.

(Counsel for defendant offered in evidence a paper entitled "Test Instruction Sheet, Engineering Department, Test No. 1175", dated 6-5-20, which was received in evidence and marked Defendant's Exhibit number 95.)

That is a test instruction sheet authorized by myself, dated 6-5-1920, authorizing the chemical laboratory and the experimental laboratory to conduct tests of batteries the negative plates of which were made entirely of lead dust.

(Counsel fer defendant offered in evidence a paper entitled "Test Instruction Sheet, Engineering Department, Test No. 1300" dated 6-30-20, which was received in evidence and marked Defendant's Exhibit number 96.)

That is a sheet containing other instructions from me personally. That KOH is a designation that we have for some inert materials and other materials commonly termed as expanders. LD refers to lead dust and KOH refers to the expander used in the negative plate. This is just a direction to make these tests. Wherever LD occurs in any of these exhibits, it refers to lead dust. By lead dust I mean the product of the German mill that we operated, the one we got from the Electric Storage Battery Company.

(Counsel for defendant offered in evidence a paper entitled Inter-departmental letter from W. L. Reinhardt, dated 6-23-20, which was received in evidence and marked Defendant's Exhibit number 97.)

That is an inter-department correspondence dated 6-23-20, authorizing the factory to make a full factory negative mix with LD material.

(Counsel for defendant offered in evidence a paper entitled Process Specification sheet of the Willard Storage Battery Company #16-C, dated 7-1-20, which was received in evidence and marked Defendant's Exhibit number 98.)

This is a process specification sheet, #16-C, which became effective July 1, 1920, and which gives the method and proportions to be used in making our various negative mixes at that time. It is the first specification that has included lead dust in the specification. This became a part of our regular factory process. That lead dust means the dust that we produced in our mill. It does not mean the oxides. The oxidation calculated in PbO that we made while we were operating this mill ranged from approximately 44 per cent up to 89 per cent. The initials K. W., something, on the top of Defendant's Exhibit 81, first sheet, are the initials of Karl W. Gasche. He was chemical engineer for the Willard Storage up to February, 1920. This document is dated October 3, 1919. I am not sure whether they came to me from him or from Mr. Norberg. Mr. Gasche is not still with the Willard Storage Battery. He left in February, 1920. He went with several other engineers to establish or found the Westinghouse Union Storage Battery Company. As to the condition of the outside or fixed non-rotating,

jacket or casing when the mill first came to my attention in Cleveland, there was a small hole in the outside of the casing for inserting a thermometer, and a small stack at the top. As I recall, this stack isn't shown on any of our drawings, but, as I recall it, it was about three feet high. Its diameter was somewhere between four and five inches. We did not operate the mill in that condition. We operated it in that condition for only a part of a day. I think if you will look in the operator's log book you will find on the first page there a notation signifying that the mill was closed down for several hours to install a vent pipe. That was on May 25. The original notebook will show that. It is a gray notebook. (A book was shown to the witness.) Yes, that is the book, Defendant's' Exhibit 91. The date that I gave was wrong. It is May 22nd instead of 25th. I will read the entry to which I refer. Here is a notation, closed down for repairs from 10:45 to 11:10 A. M.; then closed down again, 12:15 to 2:45 P. M. Reason for the same, put up safety guard and put on vent for heat regulation. I am quite certain that the pipe was installed, but that is the only written record that we have of it. There was an opening in the top when it was received by us.

We had a man named Russell. He was the chief operator of the mill. He left the Willard Company late in 1920 or early '21. We had a man, Mr. Gasche, K. W. G., that I told you about before.

Regarding what Willard did with the lead dust that constituted the product of the operation of this mill, we first made a few preliminary runs, and then about June 2nd or thereabouts we closed the mill down and made some negative plates and put them on test, and the mill was closed down then until the latter part of June, 1920, until we could find out if the plates were satisfactory.

After we started up the second time, the regular factory process specification mentioned before was issued and we used the material in regular production of plates. We continued that and used up all of the material shortly after it was made. We did reserve about a thousand pounds as a reference sample. It was used up later on. We used the lead dust one hundred per cent, plus the usual expanders.

With respect to pasting, pasting is, first, you mix the material with a satisfactory liquid, until you form a paste. This paste then is forced into a framework called a grid, and then the plates are either dried or pickled, and after that operation they are formed. We used a liquid in pasting, and the complete details and amounts are disclosed in the exhibit. I have the exhibit here.

MR. MORRIS: This has to do with Patent 479, if your Honor please.

Defendant's Exhibit 98 shows 50,350 C. C.'s per thousand pounds mixed.

THE COURT: Well, but, really, isn't the essence of that patent the same thing that all the others are?

MR. MORRIS: I think it is.

THE COURT: After all, it is the powder, isn't it?

MR. MORRIS: That is as I construe it.

THE COURT: The method of pasting these plates I don't think was patented, it really wasn't claimed in this patent, isn't that correct?

MR. WHITCOMB: Pardon me?

THE COURT: Well, I mean, this patent depends on the same thing all the others do.

MR. WHITCOMB: Fundamentally, sure.

THE COURT: That is, it depends on the product claims of the other patents, it is using a certain kind of powder in a perfectly well-known process.

MR. WHITCOMB: Substantially well-known mix, yes.

THE COURT: Well, now, I mean the process, there was nothing patentable, was there, about taking plates and smearing paste on them.

MR. WHITCOMB: No, it hinges on the powder.

THE COURT: What?

MR. WHITCOMB: It hinges on the powder.

THE COURT: Hinges on the powder; I am wondering whether it is necessary to go into the process.

MR. MORRIS: I expect to show the percentage of water—

THE COURT: Yes, it is all right, as far as that goes, but the entire process I do not believe is really in issue.

MR. MORRIS: We thought not, but we thought it desirable to show that the only thing in that patent, if anything at all, was the powder that was being used as the basis for the mix.

THE COURT: Well, I think that that is pretty nearly conceded by the plaintiff.

MR. MORRIS: If it is—

THE COURT: Am I right in saying that?

MR. WHITCOMB: Why, of course, we claim—

THE COURT: It saves a lot of time if it is so, but, on the other hand, don't do it unless—

MR. WHITCOMB: We claim that that is an inventive concept, however,—

THE COURT: What?

MR. WHITCOMB: We claim that that is an inventive concept, however, to use this powder.

THE COURT: Well, it is one of the elements of the combination which go to make up the process.

MR. WHITCOMB: Yes, otherwise that is a true statement.

THE COURT: Well, I think that is right.

I have calculated the amount of water that we used for three hundred grams. It varies between 40.7 and 42 C. C.'s for three hundred grams of the powder. Of course, you must take into consideration that there is additional water added at the end of the mix to make the mix to the proper consistency. They were dried in what was commonly known as a counter current dried, which is a tunnel drier, about two hundred feet in length, that is the plates were dried after we had put the mix on the grid, were dried in the manner I have just specified. The plates that were so made went into regular production. They were sold in the regular course of business.

MR. MORRIS: As Your Honor is advised, we operated a mill in Toronto in January, 1935, when several of plaintiffs' representatives were present, both plaintiffs' and defendant's representatives were present. The defendant handed to plaintiffs' representatives on that day certain blue prints, 1, 2, 3, 4, 5, I think, copies of which we have

here, and they were invited to compare the construction of the mill as operated on January 11, 1935 with those drawings. If they care to stipulate that fact and that those drawings show the construction of the mill in Toronto we will offer those drawings in evidence now. If not, it will be necessary for us to bring a witness from Cleveland or Toronto to show that fact.

THE COURT: Was this the same Willard mill that was taken up there?

MR. MORRIS: No, sir, this mill—may I follow the history, it has been testified to?—was erected in Philadelphia, operated there, and after a certain period of time was sent to the Willard Storage Battery in Celveland, and it was operated there for a time, and then was shipped back to Philadelphia, and then it was put in a storage room and some time, Mr. Smith said he didn't know exactly when, the mill, that particular mill, was disposed of for scrap.

Now, the mill that was operated in Toronto was one of the mills of the Willard Storage Battery Company in regular installation. It was changed, it needed only a few minor changes, but those minor changes were made to make it harmonize completely, with the exception of two of the small perforations in the drum, I think.

THE COURT: Yes, I remember that, but, now where was that mill built? The Toronto mill was built in Cleveland?

THE WITNESS: No.

MR. MORRIS: I haven't any idea where that—

THE COURT: Where was that built?

MR. WHITCOMB: London, some of the parts.

THE COURT: It was installed the first time in Toronto?

THE WITNESS: Yes.

THE COURT: It was not installed anywhere in America?

THE WITNESS: There is a similar one installed in America.

THE COURT: In the United States, I mean.

THE WITNESS: There is a similar one.

THE COURT: I know, but this particular mill has always been at Toronto.

THE WITNESS: Yes, that particular one has always been at Toronto.

THE COURT: I understand.

MR. MORRIS: We had no product of our 1916 operations, and we wanted to produce a product by a like mill—

THE COURT: Yes.

MR. MORRIS: —under like circumstances and like operation.

THE COURT: I understand.

MR. MORRIS: And I want to show by these drawings that the mill at Toronto did correspond in all particulars with the Philadelphia mill, the drawings of which have been produced.

THE COURT: Well, all you can ask them to say is that the drawings that they handed you are correct drawings—

MR. WHITCOMB: Of the Toronto.

THE COURT: —of the Toronto mill. Is that all right?

MR. WHITCOMB: Yes, I think we probably can go that far.

MR. MORRIS: You have those copies, haven't you?

MR. WHITCOMB: Sure.

MR. MORRIS: No, I am not asking you to go any further than that.

THE COURT: Well, you can think these two propositions over. Is there anything else you think can be eliminated by stipulation?

MR. MORRIS: It can be stipulated, I assume, that Dr. Wilson took samples of the run at Toronto on January 11, 1935, and that those samples were distributed between the respective parties.

MR. WHITCOMB: Sure.

THE COURT: That can be stipulated right away.

Cross-examination.

By MR. WHITCOMB:

The practice of the Willard Company concerning any drawings made compared with the structure that is made from the drawings is that they usually correspond. There might be some minor details that are not in the drawing. I wouldn't say that it was common practice to have differences. I would say the common practice is to have them accurate. It is usually the plan to have them conform to the Nth degree, as it were, but as construction progresses there

might be some changes that are not recorded on the drawing. I believe this drawing, Defendant's Exhibit 83, was made after we received the mill from Philadelphia. (The drawing was shown to the witness.) I can't see the date of that drawing from here. (The original was shown to the witness.) 10-22-19, October 1919. I am not positive but I imagine that was after we received the mill from Philadelphia. As I recall it, there was a small pipe extending two or three feet above the mill when we received it. It did not extend to the roof. For a few preliminary runs we operated it inside the building to test out the motor and things of that sort. I saw it run. After that the pipe was completed and run to the outside. There was a damper in it. That was right over the mill. The purpose of that was for heat regulation, the regulation of the temperature in the mill. The size of the pipe was between four and five inches in diameter, as I recall it. Referring to Plaintiffs' Exhibit 43, any material being made was passing down and any air was passing the other way. If you had too much draft, or, in other words, if you had a high stack, which would create a draft, there is a possibility that you might lift some of the finer material. Our stack was not that high. I don't believe we had enough draft to force very much out. There was a little that would leak out on the second floor of the mill building at times.

I believe there were five oxides of lead listed in the literature. The first one is lead suboxide. The chemical formula is Pb_2O. The next one is lead monoxide, commonly called litharge, PbO. The next one is sesquioxide, Pb_2O_3, I believe. The next one is red lead Pb_3O_4. The next one is lead peroxide, PbO_2. I imagine I have known them as such since 1918 or 1919. I know about that in general but not so specifically when I went to the Willard in 1918.

Re-direct examination.

By Mr. Morris:

I am not positive that there are five oxides of lead. I referred to finding five oxides of lead in the literature. I don't deem myself sufficiently of an expert to be able to say whether or not there is a substance in existence which is Pb_2O. I don't really consider myself competent to state what the composition of this powder was, the chemical composition. My testimony with respect to that has been not what it contained but what it contained if calculated as PbO.

When the mill that we received from Philadelphia was run with the stub stack on it, we got plenty of lead dust, fine lead dust, out in the room. Some dust did go up the stub stack that we had.

Mr. Whitcomb: We will stipulate, your drawings were correct as to the Toronto plant.

The Court: You haven't yet, you said you were going to think over the stipulation.

Mr. Whitcomb: The drawings, we don't say they are the same as the other plant, we say the drawings—

The Court: All right, let's get that much on the record anyhow.

Mr. Whitcomb: We say they are not.

The Court: That is all right.

Mr. Morris: I am going to prove what they are, so I now understand that it is stipulated by and between counsel for the respective parties that the following drawings truly and correctly represent the mill that was operated by defendant at Toronto, Canada, on January 11, 1935, some of

the product of which was distributed by Dr. Wilson to the respective parties and has been referred to and will be referred to in this case as the Toronto product.

MR. WHITCOMB: Yes, subject to any error that might actually occur.

MR. MORRIS: Oh, yes. Now, will you check these with me?

THE COURT: That is so stipulated, and you said the following exhibits.

MR. MORRIS: I am going to offer them right now. That is A, B, C, D, and E in my book.

(Discussion off the record.)

MR. MORRIS: The drawings showing the Toronto mill as used by us are offered in evidence as Defendant's Exhibits 99 to 103, inclusive.

(Blue print of Willard Battery Company, entitled "Lower Hopper and Discharge Chute", dated 12/17/34, was marked Defendant's Exhibit number 99.

Blue print of Willard Storage Battery Company of Canada, Limited, entitled "Perforated Revolving Drum with Screen", dated 1-9-35, was marked Defendant's Exhibit number 100.

Blue print of Willard Storage Battery Co. of Canada, Limited, entitled "Perforated Revolving Drum with Screen", dated 1-9-35, was marked Defendant's Exhibit number 101.

Blue print of Willard Battery Co., Toronto, Canada, entitled "Number and diameter of holes checked by C. A. Hall, H. B. Lockwood", dated

12-17-34, was marked Defendant's Exhibit number 102.

Blue print of Willard Storage Battery Co., Toronto, Canada, for Natural Draft Vent and Quadrant and Butterfly Valve, dated 12-17-34, was marked Defendant's Exhibit number 103.)

(The witness resuming testified):

I have a copy of the sheet that you gave me this morning. I have compared the drawings, Defendant's Exhibits 99 to 103 inclusive, just offered in evidence, showing the structure of the Toronto mill, with the drawing of the German mill as used by me and I will tell you what difference in mechanical structure I found. The Abbe drawing does not show a stack on our German mill. That is right. In essential details it truly represented the German mill otherwise. There was a very small difference in the number of holes. For example, in the Canadian mill there were 1480 holes and the old German mill had 1482 in the drum cylinder itself. There was a difference in the number of rows of holes also. The Canadian mill had 88 rows of holes and the German mill had 52. In the Canadian mill we had 48 rows of 8 holes each, and 24 rows of 27 holes each, and 16 rows of 28 each, while in the German mill we had 26 rows of 29 holes each and 26 rows of 28 holes each.

The diameter and length of the cylinder as far as we are able to determine from the prints, were identical.

The small end of the hole is identical, that is, .116 inches, and the top, there is a slight variation there, the large end of the hole in the Canadian mill was 13/32, while—did I say Canadian, or German?

Q. Canadian.

These holes are somewhat tapered in the inside portion there where the lead balls are. This same dimension on the German mill was 4/10 of an inch. On the other it was 13/32. The Canadian mill had no manholes or things of that sort on the sides for inspection, while the German mill had one man hole and one hand hole. These were closed during operation. The vent pipe which extended out through the roof was ten inches in diameter, while my recollection of our own vent pipe was between four and five inches, the Canadian mill. Our vent pipe was vertical over the drum while the Canadian was sloping. The delivery pipe from the shell to the container or the receiver for the oxide was eight inches in diameter on the Canadian mill while our pipe was six inches in diameter, and the inside diameter of the trunnion on the Canadian mill was ten inches, and the old German mill, seven inches.

Now, the delivery hood over the lead dust receptacle in the Canadian mill had one hole with a sliding shutter, while the German mill had two holes with rotating slides. I don't believe I know what the respective area of the aggregate of the one hole in the Canadian and the aggregate of the two holes in the mill used by us. I did not find any other mechanical differences in the two structures. I do not find any functional differences in the two machines.

Re-cross-examination.

By Mr. Whitcomb:

Comparing the area of the vent pipe in the Toronto with the so-called German mill, if one is ten inches in diameter in Toronto and four or five in the German, the cross-sectional area will be approximately four times as much. It varies as the square. If it is five

inches you would have twenty-five in the German and one hundred in the Canadian. I just pointed out the differences in these trunnions. The trunnion is the opening where the material is fed into the mill. I just pointed out that that was a difference between the two mills. There was a larger opening in the Toronto mill than in the German mill. A ratio of ten inches to seven inches in diameter and the question of area would be the same, vary as the square rather than the mere straight difference.

We did not make any attempt to collect the dust in the room or in the roof at the Willard plant. It was not significant enough.

Re-direct-examination.

By Mr. Morris:

There was a damper in the Canadian vent pipe or stack as well as a damper in our Cleveland mill. The effect of those dampers would be to regulate the amount of air through the mill. It is possible that we could get the same amount of air through our ten inch sloping Canadian stack by our damper as we got through our five inch vertical stack in our German mill. You can damper them down so that you can get the same amount of air through either one. You could get four times as much through the ten inch stack as through a five inch stack, other conditions being the same. The trunnion openings were closed in each case. Of course, there was slight leakage around.

Re-cross-examination.

By Mr. Whitcomb:

The Willard plant now manufactures some and buys some oxides. We have Hardinge mills similar to the ones in Philadelphia. At the moment I can't tell

you whether we now have six or eight. I think those were put in in 1928. We installed the whole equipment as many as we have now, at one time. Before that time we purchased some of our oxides from the Electric Storage Battery Company in Philadelphia. The ratio of the amounts we purchased compared with the amounts made from the German mill probably was not as high as one hundred to one at that time. It was hardly that big. I would say probably—well, I don't really know. There wasn't a large portion of our production.

THE COURT: That is a question that nobody has answered, and it might be of some importance.

MR. WHITCOMB: Yes, I called for figures.

THE COURT: Well, you can't get even a guess out of anybody on the matter of what proportion of the total requirement were made by these mills.

MR. MORRIS: Well, we will give you those figures—

THE COURT: Well, all right.

MR. MORRIS: —if you want them.

THE COURT: I don't know whether it is important, or not.

MR. WHITCOMB: We have asked for them. We want them.

MR. MORRIS: My thought about the situation is this. We concede freely that the product that was bought by us in 1916 and 1918 was many, many times as great as that that was being manufactured by the German mill. We hadn't come with those figures, and I think the witnesses are correct in not guessing. Your Honor doesn't want guessing.

THE COURT: Well, maybe they are, I don't know. I just suggest. I don't know whether it is even important or not, but it might be, and it just seems to me that is one question that you just get absolutely nothing from.

MR. MORRIS: Well, we don't know, our people don't know. We haven't looked up what our production was in those years.

THE COURT: Well, it is all right. It seems to me they must know whether it is three times, or a hundred times, or a thousand times, they must know more than they say.

MR. MORRIS: No, but they are guessing—

THE COURT: I don't know how much—

MR. MORRIS: If they would give an answer it would be a pure guess.

THE COURT: Well, maybe so.

MR. MORRIS: I will give you the figures.

THE COURT: All right.

MR. MORRIS: Or, again—well, we will give you the figures.

I don't know the exact date when the mill was shipped back to Philadelphia. I don't know the approximate date, it was, as I recall it, some time in 1921. From 1921 to 1928 we purchased all our oxides.

Re-direct-examination.

By MR. MORRIS:

If you had a Shimadzu mill and it had all the advantages that are given to it in patent '149, producing a hundred kilograms a hour, it would have taken

approximately four of those mills to produce a thousand pounds of powder an hour. A Hardinge mill can turn out somewhere between eleven hundred and twelve hundred pounds an hour. So that even if you had had the best Shimadzu mill, it would have taken four of them to equal one Hardinge mill and then four wouldn't have been quite as good as one. There are approximately two and a half pounds of powder to a kilogram, if my memory is right. I don't know that any Shimadzu mill would turn out a hundred kilograms per hour if made in accordance with the specification of the patent and operated in accordance with that specification.

Re-cross-examination.

By Mr. Whitcomb:

I don't know that it would not.

William Ernest Kershaw, a witness on behalf of defendant, was recalled.

Re-direct-examination.

By Mr. Morris:

(Notebook containing pages marked Defendant's Exhibit 16, 17, was shown to the witness.) The third page from the end of it contains a note which is in my handwriting. It shows the date of the employment of Mr. Benjamin Shablin, it reads, date employed, 7-3-16.

(The page from the notebook of the witness Kershaw was thereupon offered and received in evidence and marked Defendant's Exhibit number 104.)

I have made a comparison similar to that made by Mr. Reinhardt between the Toronto mill and the German mill operated by us in Philadelphia. I find the same mechanical differences as those testified to by Mr. Reinhardt. I find no functional difference. The Toronto mill was operated under my direction. It was so operated on January 11, 1935. We have a log sheet of that day.

(Counsel for defendant thereupon offered in evidence the following exhibits, which were received and marked as indicated:

(Records of Toronto mill for January 9, 1935 were marked Defendant's Exhibit number 105.

Records of Toronto mill for January 10, 1935 were marked Defendant's Exhibit number 106.

Records of Toronto mill for January 11, 1935, were marked Defendant's Exhibit number 107.)

The witness, resuming, testified:

I recall that representatives of the plaintiff were present.

MR. MORRIS: Can we stipulate, Mr. Whitcomb, that you and who else on your side were there on January 11th?

MR. WHITCOMB: Do you want all the men listed? It is all right.

MR. MORRIS: Well, you had your technical men and legal—

MR. WHITCOMB: Mr. Wood, Mr. Newton, since deceased,—

MR. MORRIS: Mr. Newton, of counsel, Mr. Souther, of counsel, Mr. Wood, a chemist from USL, Mr. Betts, of counsel. Who is Mr. Reid.

MR. WHITCOMB: He is a chemist.

MR. MORRIS: Mr. Reid, a chemist, Mr. Whitcomb, Mr. Ishimura, and Mr.—

MR. WHITCOMB: Yamaoka.

MR. MORRIS: Mr. Yamaoka, for plaintiffs, and the defendant also had its—

MR. WHITCOMB: We don't know the defendants so well.

MR. MORRIS: I see. The defendant, of course, had its representatives there. Mr. Kershaw was one.

MR. WHITCOMB: That is an error, Mr. Betts is of counsel, not a chemist. You read it as chemist.

MR. MORRIS: No, I think Mr. Wood is chemist.

MR. WHITCOMB: Mr. Reid, Mr. Wood, and Mr. Betts is a lawyer.

MR. MORRIS: Of course, Mr. Betts, of counsel, and I apologize if I referred to him as chemist.

(The following exhibits were thereupon offered and received in evidence and marked as indicated:

(Laboratory test of run of Toronto mill of January 11, 1935 were marked Defendant's Exhibit number 108.

Records of operation of lead dust mill in Toronto for January 9th, 10th and 11th, 1935 were marked Defendant's Exhibit number 109.)

The witness, resuming, testified: Comparing the method of operation of the Toronto mill as run on those days and particularly on January 11, 1935, with our method of operating the German mill in Philadelphia in 1916, 1917 and 1918, we operated at Toronto as closely in accord with the method of operation formerly employed at Philadelphia as we could. The temperatures, revolutions and output, ventilation, and so forth, was held within close approximation to what we had run in the German mill. In order to do that I had some of the records of the previous runs of the German mill, which have been offered as exhibits, with me for the purpose of comparison. The logs of the respective runs will show the comparison to which I am testifying. They are in reasonably close agreement.

Re-cross-examination.

By Mr. Whitcomb:

I am connected with Exide. I have been continuously since 1906.

Q. Please refer to Defendant's Exhibit D-80, and it seems we find duplicate runs for the same week, and explain what that is. Have you got yours?

A. I have mine. Can you tell me what week you are referring to?

Q. 8-28 to 9-2, 1916, on the tab, it is about the third sheet from the top, third and fourth.

A. Without taking too much time to compare them—

Q. Well, take all the time you want.

A. —item by item, it appears they are duplicates, with the exception that the second record in my folder has been carried a little further in regard to the equivalent weight of balls per hour than the first record.

Q. Well, how does it come there are two?

A. One of those is in Kahn's handwriting, and the other one is in mine, but I can't explain otherwise why there are two. I suppose we both made out records independently and they got in the folder.

Q. As a matter of fact, they are not exactly the same, are they?

A. No, they are not exactly the same.

Q. Do you have a chart corresponding to Exhibit 109 for the operation—

A. I have a print of it, yes, sir.

Q. Have you a chart corresponding to that for the early mills?

A. There is no single chart, but the comparison is made between this and a number of charts of the early mill.

Q. Well, do they appear on this chart?

A. They do not, no.

Q. Well, have you got those others?

A. I am not sure—

Q. In other words, you presented one-half of a comparison, namely, what you did in Toronto. Now, have you got the charts for what you did in Philadelphia?

A. I don't know whether they are here. Such charts have been made, and as far as having the other record, you can make the comparison yourself, if you choose.

Q. But you haven't got them here?

A. I personally haven't got them. They may be in our files, I am not sure.

Q. Will you produce those if you can find them before the case is closed?

Mr. Morris: What chart is it you want?

Mr. Whitcomb: Comparison chart for the

operation in the Philadelphia mill compared to this Exhibit 109.

MR. MORRIS: That is, I understand that, Mr. Whitcomb, what you are asking for is a comparison chart.

MR. WHITCOMB: Yes.

MR. MORRIS: That is, where the charts were made separately, I mean, where the Philadelphia mill and this mill were put on the same sheet, is that what you mean?

MR. WHITCOMB: If that is the case. He said they were, he said he had charts.

MR. NORRIS: I don't whether—I think not, I think we had a chart showing a comparison on the same sheet of one week's run of Philadelphia. I thought that was not a fair comparison, because anybody can make the comparison by every weeks' run made in Philadelphia with our Toronto mill. I, therefore, have not produced any drawing of that kind, because it is not a full, could not in itself be a full disclosure. I will give you that week's drawing, if you want it, if I still have it. I don't know whether I have it or not. Do you want it?

MR. WHITCOMB: Well, we want the one the witness has referred to more than we want yours. The witness says he may have some—

The witness, resuming, testified: I said I have none here. I think I will have in Philadelphia and I think our counsel has a copy of one of them.

MR. WHITCOMB: Well, those are the ones we would like to see.

MR. MORRIS: Here is the one to which I have referred, and it is the only one I have seen.

(Mr. Morris produced a paper.)

(The witness examined the paper.)
This is the one I mean.

(Counsel for plaintiffs thereupon offered in evidence as Plaintiffs' Exhibit 45 comparison chart of operation of Philadelphia and Toronto mills, which was marked Plaintiffs' Exhibit number 45 for identification.)

As far as my knowledge and belief goes, the apparatus covered with a canvas at Toronto has nothing whatever to do with the operation of the Toronto mill under myself. I can't say whether the material was taken off of the mill in order to change it to make it run. Some material was taken off. I could see where it had been detached.

I can quote the textbooks as to what the oxides of lead are. Without the textbooks, I would say that the five oxides of lead are: lead suboxide, lead monoxide, that is litharge, lead sesqui-oxide, red lead, and lead dioxide or peroxide. I would so have listed the oxides of lead if asked a similar question in, say, 1920.

Re-direct-examination.

By MR. MORRIS:

I do not deem myself competent to say whether there is any such compound as suboxide of lead. It is a question which I cannot answer on account of limited knowledge. I would not say it is impossible to determine whether there is lead suboxide.

Defendant's evidence suspended.

Plaintiffs' evidence resumed.

GEORGE L. CLARK, a witness on behalf of plaintiffs, was recalled.

Re-cross-examination.

By MR. MORRIS:

Q. Dr. Clark, on pages 396 and 397 of the record, and particularly on 397, I find that you answered thusly in reply to this question of mine, which began on 396; "Q. Now, did you make any X-ray patterns, diffraction patterns, for any products other than those disclosed as Exhibit 21?"—Exhibit 21 being what looks like a shelf of books of the fourteen patterns. You replied: "A. Yes, those, the actual films are in evidence for many more samples than that, and then, of course, we have made, as I said, in the course of this whole investigation possibly five hundred exposures.

"Q. What other products did you analyze spectographically—would that be a correct term? No, it isn't—by the X-ray process?

"A. By diffraction method, yes.

"Q. Diffraction method.

"A. Well, as I said yesterday, we did about one hundred and twenty-five lead oxalate experiments, and, of course, we have had a large number of samples. . . ."

Later, I asked for the production of those measurement sheets or work sheets, and day before yesterday Mr. Shaffer was good enough to hand to me a few sheets of paper, and I agreed with him that he could retain them and get them photostated so that we could have copied them, but my question was to produce the documents which you sent in reply to my request for your work sheets in connection with your diffraction work in this case.

Shall we start with any particular one, and tell me what it is so that I can mark it on my copy?

A. All right.

Q. Will you take out one and let me see which it is?

A. We might start with this one, "Corrected and revised measurements of spacings."

Q. Corrected and revised measurements of spacings.

MR. MORRIS: Which we will offer in evidence as Defendant's Exhibit—

MR. WHITCOMB: We would be glad to introduce them. Is there any objection to splitting them up?

MR. MORRIS: Not at all. I will introduce—

MR. WHITCOMB: Plaintiffs' Exhibit 46—is that all right with you? I will introduce it.

MR. MORRIS: I don't care at all, let us get them in some order.

MR. WHITCOMB: Yes. Would you like me to introduce all the exhibits he has produced?

MR. MORRIS: No, not particularly.

MR. WHITCOMB: You will have a number on each one.

MR. MORRIS: They will have your number or we will have my number, I am not concerned about that. Do you want to introduce them?

MR. WHITCOMB: Yes. Counsel for plaintiffs offers in evidence as Plaintiffs' Exhibit 46, sheet, "Corrected and revised measurements of spacings, highest accuracy."

(Paper headed "Corrected and revised meas-

urements of spacings, (Highest Accuracy)" was marked Plaintiffs' Exhibit Number 46.)

THE COURT: Let me just see what it looks like.

(Plaintiffs' Exhibit Number 46 was handed to the court.)

MR. WHITCOMB: Counsel for plaintiffs offers in evidence as Plaintiffs' Exhibit Number 47, the next sheet produced by the witness which is—

THE WITNESS: Tabulation of spacings for—lead oxide, lead and lead suboxide.

(A paper headed "Tetragonal PbO" was marked Plaintiffs' Exhibit Number 47.)

MR. WHITCOMB: Counsel for plaintiffs offers in evidence the next sheet produced by the plaintiffs' expert, and asks the clerk to mark the same Plaintiffs' Exhibit 48, which is—

THE WITNESS: Experimental tabulation pattern for pure lead.

(A paper headed "Pb" was marked Plaintiffs' Exhibit Number 48.)

MR. WHITCOMB: Counsel for plaintiffs offers in evidence the next sheet produced by the plaintiffs' expert witness and asks the clerk to mark the same Plaintiffs' Exhibit Number 49, which is—

THE WITNESS: Experimental tabulation of tetragonal PbO.

(A paper headed "PbO" was marked Plaintiffs' Exhibit Number 49.)

MR. WHITCOMB: Counsel for plaintiffs of-

fers in evidence the next sheet produced by the witness—

THE WITNESS: The same for silver oxide.

MR. WHITCOMB: —and asks the clerk to mark the same Plaintiffs' Exhibit 50.

(A paper headed "Ag_2O" was marked Plaintiffs' Exhibit Number 50.)

MR. WHITCOMB: Counsel for plaintiffs offers in evidence—

THE WITNESS: Same for cupreous oxide.

MR. WHITCOMB: —and asks the clerk to mark the same Plaintiffs' Exhibit 51.

(A paper headed "Cw_2O" was marked Plaintiffs' Exhibit Number 51.)

MR. WHITCOMB: Counsel for plaintiffs offers in evidence the next sheet produced by the witness, which is—

THE WITNESS: Comparative measurements with Ferrari's results, Pb_2O.

MR. WHITCOMB: —and asks the clerk to mark the same Plaintiffs' Exhibit Number 52.

(A paper headed, "Comparison and calibration for Pb_2O in Exide, Prest-O-Lite, oxalate" was marked Plaintiffs' Exhibit Number 52.)

MR. WHITCOMB: Counsel for plaintiffs offers in evidence the next sheet produced by the witness which is—

THE WITNESS: Page 8 of the research log, and complete tabulation of fractionated Exide sample.

MR. WHITCOMB: —and asks the clerk to mark the same Plaintiffs' Exhibit Number 53.

(A paper headed "Research log, fractionated Exide Sample" was marked Plaintiffs' Exhibit Number 53.)

MR. WHITCOMB: Counsel for plaintiffs offers in evidence the film—

THE WITNESS: The next is a special nickel filtered copper pattern, copper radiation pattern for the fractionated sample of Exide.

MR. WHITCOMB: —referred to—.

THE WITNESS: Referred to on that sheet.

MR. WHITCOMB: Exhibit Number 53.

THE WITNESS: Yes.

(An envelope containing a film entitled, "Special nickel filtered radiation" was marked Plaintiffs' Exhibit Number 54.)

MR. WHITCOMB: Counsel for plaintiffs offers in evidence the film produced by the witness which the clerk has marked Plaintiffs' Exhibit Number 54. The next—

THE WITNESS: The like pattern of fractionated sample of Exide, finest fraction of Exide material from which the preceding film was made.

By MR. WHITCOMB:

Q. In your opinion, this is what?

A. That gives the pattern corresponding to what we claim as suboxide.

MR. WHITCOMB: Counsel for plaintiffs introduces the film—

THE COURT: That is it, is it?

THE WITNESS: That is it.

MR. WHITCOMB: —and asks the clerk to mark the same Plaintiffs' Exhibit Number 55.

(A glass tube with a label marked (fractionated samples) was marked Plaintiffs' Exhibit Number 55.)

MR. WHITCOMB: The next sheet produced is—

THE WITNESS: Page 12 from the research log, calibration of the camera for the preceding—

MR. WHITCOMB: —and asks the clerk to mark the same Plaintiffs' Exhibit Number 56.

(A paper headed "Complete tabulations for C83 film," was marked Plaintiffs' Exhibit Number 56.)

THE WITNESS: Calibration of camera Number 3, with the lead, using constancy for metallic lead, offered by Professor W. P. Davey, I think.

By MR. WHITCOMB:

Q. Who is in the court representing the defendant?

A. Yes.

MR. MORRIS: And will testify for defendant?

THE WITNESS: Well—next is a calibration curve for reading spacings quickly directly from linear displacements of lines on films. The camera being the one used for the D samples, the Exide samples.

MR. WHITCOMB: Counsel for plaintiffs of-

fers in evidence the curve and asks the clerk to mark the same Plaintiffs' Exhibit Number 57.

(A paper headed "Curves for reading spacings directly from linear displacements of lines" was marked Plaintiffs' Exhibit Number 57.)

THE WITNESS: The next is several sheets from rough sheets from a progress report simply illustrating the general precautions as first used in this work, calibration and so on.

MR. WHITCOMB: Counsel for plaintiffs offers in evidence the sheets produced by the witness and asks the clerk to mark the same Plaintiffs' Exhibit Number 58. (Progress report—14 sheets.)

MR. WHITCOMB: The next sheet—

THE WITNESS: Next sheet is a calculation sheet for a particular film, C83 similar to the B.

MR. WHITCOMB: Counsel for plaintiffs offers in evidence the sheet produced by the witness and asks the clerk to mark the same Plaintiffs' Exhibit Number 59.

THE WITNESS: Film having been aged and exposed. Exide sample exposed to air, that pattern being made the twelfth of September, 1935 showing the absence of even traces of lead suboxide.

By MR. WHITCOMB:

Q. What film is that?

A. Sample exposed to air. This is an Exide sample corresponding to DIF which has been left open in the air.

Q. Is there something in the record to compare this with?

A. Yes.

MR. WHITCOMB: Mark it for identification as Plaintiffs' Exhibit Number 60.

(Aged & exposed Exide sample.)

THE WITNESS: I would like to introduce—

MR. MORRIS: You don't introduce anything. I have never seen that.

THE WITNESS: No.

By MR. MORRIS:

Q. It has not been hitherto produced for my inspection?

A. No.

Q. All the papers that have been produced by you pursuant to my request are the ones which now have been marked in evidence as plaintiffs' exhibits?

A. Yes.

MR. MORRIS: I am not concerned with what you produced after that, but I want to know where the papers furnished me stop.

Is there anything more you want?

MR. WHITCOMB: He has them there, we are willing to have them, but, to date, I don't know whether either side wants them.

By MR. MORRIS:

Q. Dr. Clark, I dont' know whether I want them or not, but I did ask you for all your work sheets and anything bearing on this case.

A. Yes.

Q. Have you any work sheets that you have not produced pursuant to my request?

A. No, this particular one here which I am speaking of now deals with measurements, the earliest meas-

urements on long General Electric film by the Hull-Davey method, and long film. They have not been produced in evidence because there have been so much better ones, but they illustrate actual measurements with the General Electric rule of some seven of the earliest samples of lead, lead oxide and so on.

Q. That has nothing to do with any work sheets of your own?

A. Except insofar as that first table that you have, the very first one, is compiled partly from the results of this, although this is not absolutely essential.

Q. You mean compiled partly from the knowledge you gained from the documents you now have at hand?

A. Yes.

Q. But what I want to get, Doctor, please, is whether these documents that you have before you now, introduced by the plaintiffs in evidence, constitute all your work sheets done in connection with this work in this case. Am I to understand that to be the fact?

A. All that I have, yes. Of course, this—

Q. That is not my question. I understand what we have are work sheets—

A. Yes.

Q. —but I don't understand whether or not I have your work sheets. I am not trying to look at the Toronto record, let us forget that.

A. Yes, sir.

Q. There is no objection to using it in rebuttal if you want to put it in, but I am not fishing for it now. Now, forget about Toronto. Have you any other work sheets?

A. This is the only thing. I didn't know I had it, because it is four or five years old.

Q. So that of the five hundred examinations made, of the five hundred exposures of one hundred

and twenty-five lead oxide experiments you kept no records, made no work sheets save those which have now been delivered into the case right—

A. Yes, sir.

Q. Eliminating Toronto?

A. Yes, and understanding also that the film itself is a work sheet and the microphotometer curves are work sheets and that much of this work has been done with a strong light viewing box and visual comparison.

Q. Tell me what Exhibit 59 is? I see nothing on it to indicate really what it is.

By Mr. Whitcomb:

(The witness examined Plaintiffs' Exhibit Number 59.)

A. This was an analysis of a whole series—I mean a typical analysis from the series C, by the way, of lead oxalate experiments. This was selected for mathematical analysis, and, really, this, the others were simply compared by visual comparison and study.

Q. May I see if I understand you right? That is, in one of your films for C, which is your symbol for lead oxalate—

A. Yes.

Q. —you made these measurements—

A. Yes.

Q. —and calculations and put them on this chart?

A. That's right.

Q. For all other of your oxalate tests you made merely ocular comparisons over that box with the glass top, with the light in it?

A. Yes.

Q. What do you call it?

A. A viewing box.

Q. Frosted glass?

A. Yes.

Q. It is like a reading desk with a frosted glass top and a light so that you can read through it?

A. Yes.

Q. You made that comparison?

A. Yes.

Q. Do you keep a book, Dr. Clark, in which your experiments are transcribed? The record of your experiments are entered?

A. Well, there has been no one single book. Of course, this has been scattered over a long period of time.

Q. Don't you, as a scientist dealing I assume with the, I presume with great accuracy, keep and study data with respect to it, in books either loose leaf or books with leaves that are not loose?

A. Much of it is.

Q. You haven't shown me a single one of those books.

A. There are pages of it found in the research log. In all of this experimental work I have compared the films very accurately and very carefully tabulated so that they could be examined at any time. That constituted a permanent record.

Q. Did Ferrari have Pb_2O?

A. Yes, he did.

MR. MORRIS: I would like to go into it a little bit after luncheon, if we convene then.

THE COURT: Shall we adjourn now?

MR. MORRIS: Yes.

THE COURT: Today we will recess at 12:00 o'clock and come back at half past one.

(Recess from 12:00 o'clock noon to 1:30 o'clock P. M.)

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